ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE,

BOMBAY PRESIDENCY,

FOR THE YEAR

1915-1916.

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ERRATA.

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Page 1, Chapter II—

Read " of " for the word " and " after the word " dressings " in line 26.

Page 2, Chapter VII—

Insert the words " of the work " after the words " favourable mention " in the last line.

Report.

Page 24—

Gujarat Cottons—Surat District—2nd Statement—

For the word " Bhs " read " Bhrs." in column 3.

M. S.

Omit figures 63 29 in column 9 against entry No. 5 ; put an asterisk (*) in their place and read the following foot-note :—

* Fifth lot being ginned in two instalments definite quantity of kapas required to gin one Khandy of lint is not available.

Page 25—

For the figures " 170·0 " read " 170·6 " in column 3 of the statement.

Page 50—

For the word " unadequately " read " inadequately " in the last line.

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No. 9637 OF 1916.

From

THE HONOURABLE MR. G. F. KEATINGE, C.I.E., I.C.S.,
Director of Agriculture, Bombay,
Poona;

To

THE CHIEF SECRETARY TO GOVERNMENT,
Revenue Department,
Bombay.

Poona, 13th October 1916.

Sir,

I have the honour to submit the Annual Report of the Agricultural Department for the year 1915-16.

CHAPTER I.

ADMINISTRATIVE.

2. During the year the expenditure of the Department was Rs. 8,21,005 as against an expenditure of Rs. 8,53,412 of the previous year, a decrease of Rs. 32,407. The expenditure on salary increased by Rs. 18,000, mainly due to the normal increments of progressive salaries, and there was an increase of Rs. 23,000 under the heading "Hydraulic Experiments", due to the necessity for rapidly expanding the work of well-boring, so as to provide against the scarcity of water in Northern Gujarát. On other items there was a general decrease, due to financial reasons. Departmental receipts, on the contrary, rose from Rs. 1,01,000 to Rs. 1,30,000. A contribution of Rs. 28,000 was received from the Trustees of the Sir Sassoon David Trust Fund. The permanent advance of Rs. 40,000 made to this Department for financing quasi-commercial operations was turned over twice during the year.

3. In the upper ranks of the Department there were considerable changes. Mr. J. B. Knight, Professor of Agriculture, continued on leave till towards the close of the year. Rao Bahadur G. K. Kelkar continued to act for him till his return, when he took furlough prior to retirement. Mr. G. S. Henderson, Deputy Director of Agriculture, Sind, was on leave till almost the end of the year, and on his return was at once transferred to Pusa. Mr. Gul Mahommad acted in Sind for four months, and then Mr. Main was transferred from the Northern Division to fill this post. On the transfer of Mr. Main to Sind in September Mr. P. C. Patil was moved from the Konkan to act as Deputy Director of Agriculture, Northern Division. Mr. Gonehalli, Extra Deputy Director of Agriculture, Konkan, remained absent on deputation throughout the year, his place being taken first by Mr. P. C. Patil, Divisional Inspector of Agriculture, Central Division, and subsequently by Mr. V. G. Gokhale, Superintendent, Agricultural College Farm. Dr. Mann and Mr. Gilbert were at their posts through the year except for privilege leave. Dr. Burns as Economic Botanist, Mr. Schutte as Agricultural Engineer and I myself as Director of Agriculture served throughout the year.

Since the close of the year Mr. Gilbert has joined the Indian Army Reserve of Officers, and we have thus lost two out of the three Deputy Directors. Twelve Veterinary Assistants have taken up military work, a number of the malis from the Botanical Garden have gone to Mesopotamia to grow vegetables for the Troops, and the greater part of the Agricultural College has been converted into a war hospital. We are therefore for the moment somewhat disorganised.

CHAPTER II.

Some Special Lines of Work.

4. In the matter of producing and introducing improved cotton seed to meet the requirements of the different cotton growing tracts the operations during the year have been recorded in detail in the reports of the various Deputy Directors. In the Surat District a second group of villages was added to the area in which we put out our improved cotton seed last year, and the area under operation was doubled. One thousand five hundred and four acres were sown with our cottons, and the average outturn of the seed cotton marketed from this area amounted to 295 lbs. per acre, which was not a bad outturn considering the unsatisfactory season in Gujarát. The total value of the produce sold was Rs. 66,462, or Rs. 44 per acre, and the advantage in price that was obtained for the produce of our seed amounted to Rs. 4,300, or Rs. 2·86 per acre, which means a premium of 6½ per cent. for our cotton over the local cotton, of which 3½ per cent. represents the advantage of ginning percentage and 3 per cent. the advantage of quality. The advantage in price is smaller than might have been expected, but the Department is much indebted to Messrs. Narandas Rajaram and Co. for the assistance which they are giving in purchasing this cotton annually. The arrangements for the marketing of this cotton are not easy to make so as to satisfy everyone, and I do not think that it will be possible for us to control effectively a larger area than this for some time to come; for our experience when we attempted to put out this seed on a much larger scale was not fortunate. So far as these operations go, the gain to the cultivators is appreciable and they are glad to get our seed and obtain the extra profit; but a gain amounting to rather less than Rs. 3 per acre in the case of an article like cotton, the price of which fluctuates so rapidly, is not enough to impress the mind of the cultivators greatly, and they are not at present disposed to take much trouble in the matter. We must aim at increasing the margin of profit much more by a continued process of seed selection, and that this is possible the figures given by the Deputy Director of Agriculture, Northern Division, regarding the valuation this year of Selection A, show to be the case. The advantage of this Selection over local cotton amounts to a premium of nearly 5 per cent. for quality and 15 per cent. for quantity (due to higher ginning percentage). When we can establish on a large scale this strain, which is worth 20 per cent. more than local cotton, the margin of advantage will be sufficient to attract the cultivators. Quantity, as represented by high ginning percentage, appears to be the most profitable thing to aim at; but the question of quality must not be neglected.

5. *American Cotton in Sind.*—That American cotton of the Triumph variety can be grown in Sind without deterioration is shown by the fact that in April 1916 a bale of our Sind-American Cotton sent to Manchester was described as "very good colour, good middling in grade, staple $1\frac{1}{16}$" to $1\frac{1}{8}$", strong" and valued at 8·20*d.* when Middling American stood at 7·90*d.* This valuation of cotton grown from seed which had been acclimatised for three years in Sind is the best that we have yet received. The Empress Mills of Nagpur and the Elgin Mills at Cawnpore which used part of the crop confirm this favourable estimate and consider the Sind-American worth ¼*d.* per lb. more than Middling American. On our Seed farm 40 bales of American cotton were produced and the best price that we could get for them worked out at under 6*d.* a lb. when Middling American was selling at Liverpool for 8·20*d.* per lb.; which looks as though we did not obtain a fair price for the produce. The American crop in Sind amounted to 560 bales. The Sind Cotton Growing Syndicate having suspended its operations for the year, this produce was purchased by Messrs. Ralli and Co. and by a Japanese Firm at the rate of Rs. 9-1-0 per maund, when the price of Sindi cotton was Rs. 8-4-0, which represent a premium of only 10 per cent. It is an unfortunate fact that much of this American cotton marketed by the cultivators was seriously mixed with Sindi cotton, which must have considerably reduced its value. How and where this adulteration took place I am unable to state. American cotton grown in Sind has a ginning percentage of 31·72, while Sindi cotton has a ginning percentage of 33·54. That is to say that from a given quantity of seed cotton about 6 per cent. less lint will be produced in the case of American cotton than from Sindi cotton. As regards the actual outturn of seed cotton per acre the matter is not yet quite

clear. Mr. Henderson estimated that the yield of seed cotton per acre was as large in the case of American as in the case of Sindi, but Mr. Main holds that it would be safer to take the outturn of American as 25 per cent. less than Sindi, since it is more susceptible to damage by *Kalar* (salt land) and is more apt to suffer at the end of the season from boll worm and red leaf curl. The extreme patchiness of the Sind soil makes accurate comparisons on a large scale difficult, but it is noteworthy that on the Seed farm we obtained an all round average of 616 lbs. per acre of American cotton on 93 acres. Still, taking Mr. Main's estimate that the produce of American cotton is 25 per cent. less than Sindi there should still be a good future for American in Sind. If the Sind cultivator is to obtain for his American seed cotton a premium of 25 per cent. over his Sindi cotton, the value of the lint must be 41½ per cent. greater. At present Bombay prices Sindi cotton is valued at Rs. 240 per *khandi* and it is agreed by competent mill owners that pure Sindi-American is worth Rs. 400 per *khandi*. This constitutes a margin of 66½ per cent. for lint, and should enable mill owners to pay the cultivator a premium of 40 per cent. for his American seed cotton provided that he brings it in pure. Such a premium would pay the Sindi cultivator handsomely, and the two questions upon which the success of American cotton in Sind now depends are—

(1) Will the margin between the value of long and short staple cotton remain at anything like its present level ?

(2) Can the Sindi cultivator be induced to bring in his American cotton unmixed with Sindi cotton ?

If these two questions can be answered in the affirmative all that we need is to secure a buying agency that will pay full value for the long stapled crop. I am glad to say that the Sind Cotton Growing Syndicate has agreed to resume its buying operations at Mirpurkhas under a revised agreement, and it is hoped that the operations of 1916-17 will settle some of the outstanding questions. In view of the fact that the seed at the ginneries was badly mixed last year it was decided to distribute only pure seed from the Seed farm. This has been sown pure, and if the cotton brought in by the cultivators is mixed, the mixing will be deliberate. Owing to the small quantity of seed issued the crop for 1916-17 will be small, but if no mixing takes place the area under American cotton can be rapidly extended in future years, provided that the present margin of advantage in value is maintained.

6. In Khándesh the work of producing and distributing N. R. Cotton seed has advanced rapidly. Nearly 200,000 lbs. of pure seed were distributed during the past season, as compared with about half this quantity the year before. There are no new features to mention in this line of work which has previously been described in detail. The seed is appreciated, and the increased profits resulting from its use in Khándesh during the year must have amounted to well over Rs. 1 lákh. This seed is now spreading to Ahmednagar and Sholápur.

7. In the Southern Marátha Country operations for the establishment of Broach and Cambodia cottons were continued. The season was not very favourable to either so far as outturn went, but good prices were obtained at the Departmental auctions. With Kumpta cotton selling at Rs. 148 *per naga*, Broach fetched in the auction prices ranging from Rs. 165 to Rs. 190 *per naga* ; and with Dhárwár American selling at Rs. 150 *per naga* Cambodia sold at prices ranging from Rs. 195 to Rs. 221 *per naga*. The Broach cotton was bought by Messrs. Tata and Co., and the Cambodia by Messrs. Forbes, Forbes, Campbell and Co., for the Gokak Mills. The value of the cotton sold at these two auctions amounted to Rs. 56,000. Some of the cotton of these varieties is disposed of privately ; but our auctions serve to fix the standard. The cultivators of the Dhárwár District have now had a number of years to make up their minds regarding the profits to be derived by substituting these cottons for the local Kumpta variety. Broach cotton does not tend to increase, while the popularity of Cambodia is spreading. It may be now taken that Broach cotton is fairly established in the Dhárwár and Bankápur Tálukas, and Cambodia cotton in the Gadag and Ron Tálukas. For other tracts we shall probably have to trust to our improved strains of Kumpta cotton. We have already begun to put these out on a fairly large scale ; and the results will be carefully watched and reported.

8. In the matter of sugarcane work we have completed a successful season. The Manjri Farm did particularly well, its best crop amounting to over 50 tons of stripped cane to the acre, yielding 13,362 lbs. of gul, worth Rs. 954. This was not produced by lavish methods, but by methods considerably more economical than those of the ordinary canal cultivator, and, after debiting every possible charge against the cane and gul, the net profit per acre worked out at Rs. 494. The net cost of this cane was only Rs. 7-6-0 per ton, which is very cheap for cane of this quality. The cheapest cane grown on the farm worked out at Rs. 7-2-0 per ton. This was a ratoon crop from Pundia cane planted on the Java method, which gave a higher yield than the plant cane. Khadya cane does remarkably well with deep planting, and with some modifications of treatment, suitable to our conditions, there appears to be a good future for the Java system in deep soils. The results of the Manjri Farm leave no doubt in my mind that from the physical point of view the Deccan is as well favoured as any part of the world for the establishment of a profitable sugar industry. The economic difficulty bars the way, but I believe that this can be overcome. The economical Manjri methods of cultivation have found favour with cultivators, and during the past year this system was adopted by cultivators over some thousand acres, mainly on the Mulla-Mutha, Nira and Ekruk Canals, though it was introduced tentatively and on a small scale also in the Ahmednagar and Násik Districts.

9. We can now claim to have done a good deal for cane growing in the Bombay Presidency. Our general work in many localities in connection with the introduction of top dressings, improved gul making, economical furnaces and more efficient crushers has been referred to for some years past and still continues. In addition to this the special district work under Mr. G. N. Sahasrabuddhe made a good start during the past year. He devoted most of his attention to the new Godavari Canals where sugarcane growing is increasing by leaps and bounds. This rapid increase in the cultivation of a crop which requires so much skill and experience, amongst cultivators who have little or no experience of irrigated crops, necessitates instruction from the first principles of cane growing down to the last refinements of handling the produce. The first essential is good cultivation, and to provide for this six implement depôts where suitable implements can be bought or hired were opened and soon became popular. Iron ploughs of various types, ridging ploughs, levellers, crushers, gul pans, juice tanks, scum strainers and gul moulds were stocked. Some of the poorer cultivators cannot at first find the money to purchase such implements, and it is usually desirable to offer them on hire. Rs. 727 were taken at these depôts as hire for implements. Green manuring with *san* was adopted on 300 acres, and 30 acres were ridged up with the *Sabul* plough, saving the costly hand labour. Top dressings of various kinds were brought and supplied to the cultivators with the requisite advice as to their use. The Chattanuga Mill which gives an extraction of 73 per cent. was introduced, and assistance and advice given with the gul making, and 30 plots of cultivators' cane were laid out on improved methods by way of instruction and demonstration. A Cane Growers' Association was formed and an Agricultural show was held. This constituted a strenuous and creditable year's work. There are many problems which have to be worked out for the Godavari tract and which necessitate a permanent sugarcane farm in that tract. Mr. Sahasrabuddhe was much handicapped during the past year for want of such a farm, for it is impossible to get accurate data from temporary plots which are liable to damage from stray cattle. I hope that it will be possible to provide for this very shortly and also to supply the additional trained staff that are needed for this work.

10. On several of the older canals in the Násik District sugarcane growing has never become popular, and much of the stored water goes to waste every year for want of people who are prepared to use it. Mr. Sahasrabuddhe extended his operations to the Girna Left Bank Canal during the past year, and as a result sugarcane cultivation has increased from 30 acres in 1915 to 97 acres in 1916, and he confidently expects that it will rise to 200 acres next year. On the Ozar Canal, too, some work was done with satisfactory results, and when staff and time permit it is hoped to extend these operations to the Palkhed and Wadali Canals.

11. Sugarcane growing has greatly fallen off in Gujarát of recent years. The causes of this are usually attributed to the set back received in the famine of

1899-1900 and to the damage done by wild pigs and white ants. In point of fact the decline of sugarcane growing dates from the eighties, and I presume that wild pigs and white ants are no worse now than formerly. It is true that the famine of 1899-1900 practically put an end to cane growing in the Ahmedabad and Kaira Districts for the time being; but it is remarkable that since then there has been no considerable revival of this kind of cultivation. A probable cause of this is the competition of gul from the canals of the Deccan and the United Provinces in the Gujarát markets, and to some extent the competition of foreign sugar. In the Surat District, however, cane is still grown on a fairly large scale, and in the Ahmedabad District the possibility of pumping water economically from the Sabaramati has revived the interest in cane growing. In Surat District the chief difficulty appears to be red rot and in Ahmedabad District white ants and the "hungriness" of the soil. We have started work at Amalsad and at Kasandra (near Ahmedabad) to study the questions involved. Natural conditions are certainly not so favourable as in the Deccan, but with the requisite knowledge I have no doubt that cane can be grown at these places at a good profit.

CHAPTER III.

General Farming Matters.

12. One of the most marked results that has been noticed in the past on our farms has been the way in which the general level of the crops grown on these farms has improved from year to year, as the weedy, ill-tilled land has been cleaned and put into "good heart" by sustained good tillage and proper rotations. Two farms in particular did well during the year in this respect. On the Jalgaon Farm of 205 acres the two crops grown are cotton and wheat. The average outturn of seed cotton per acre was 777 lbs., while some plots yielded as high as 1,380 lbs. per acre; and of wheat the average outturn amounted to 911 lbs. per acre, while some plots yielded as high as 1,115 lbs. per acre. The total outturn of the farm fetched Rs. 16,000 and the cost amounted to Rs. 15,000 including rent, establishment and all charges, over Rs. 2,000 of which were capital charges.

On the Manjri Farm of 48 acres the value of the produce during the year was Rs. 15,000, while the total cost of the farm was Rs. 18,000. When it is considered that the farm staff does a large amount of purely research work and a large amount of purely instructional work both on and off the farm, this result is very creditable. If a sum of Rs. 3,000 debitable to capital expenditure for building and apparatus be deducted from the cost, the farm will be found to have paid its own way and its profits to have paid for the scientific, instructional and demonstrational work undertaken by the staff.

13. Good cultivation depends on good implements and good draught cattle. Our implement campaign I regard as one of the most important lines of work which we undertake. On all our farms improved implements can be bought and hired, and we have now a large number of depôts at which implements are kept for sale and hire and spare parts stocked, and each year we continue to add to the number of such depôts. So many implements are now bought direct from the dealers both by Agricultural Associations, Co-operative Societies and by individuals that it is not possible to compute the number sold annually but the figures at a few places may be mentioned.

Agricultural College Farm	.. Rs.	27,600 (sale)
	,,	350 (charges for hire)
Depôts in North Deccan	.. ,,	7,000 (sale) and
	,,	1,800 (charges for hire)
By the farms and depôts in Southern Division.	,,	26,000 (sale) and
	,,	600 (charges for hire)
Bijápur Agricultural Association	.. ,,	7,000 (sale)
Konkan farms	.. ,,	1,500 (sale)

14. The difficulty of providing adequate draught cattle for tillage purposes is more serious and is largely economic in its nature. I do not here refer to the problems of cattle breeding which have been dealt with at length elsewhere, but to the possibility of equipping cultivators with adequate plough cattle. Here we are met by the problem that while cultivators will themselves deplore the fact that they have not got sufficient cattle, and others will expatiate volubly on this theme on behalf of the cultivators, it is and must be the object of most cultivators to keep as few draught cattle as possible. In the highly cultivated districts grazing is very scarce and the cost of feeding draught cattle is considerable. When draught cattle are not working they are costing money without bringing in any return; and it is extraordinary in many tracts how very few days field work there is for cattle to do in the year under existing conditions and practices. In the Konkan the period of field work for cattle is practically confined to June and July. In parts of the Eastern Deccan, where ploughing is hardly practised, the work consists merely of harrowing and sowing for the rabi crop. No doubt in part of the period from August to October when the land is in suitable condition there is a great rush of work, but for the rest of the year there is little or no field work for the bullocks to do. Even the best cultivators cut down their bullocks to one pair for about 25 acres and with inferior cultivators the number is less. If you were to present a pair of fine bullocks to a man with 10 acres or less of rabi land in a region where there was little free grazing, coupled with the condition that he must not sell them or give them away, he would have the alternative of starving them or of becoming a cartman himself, otherwise they would rapidly eat him out of house and home. With the existing organisation bullocks constitute a serious drain on the resources of the larger cultivators. The smaller man solves the difficulty by keeping none. I do not here propose to go further into the question or to suggest possible remedies, but merely wish to indicate the situation. There is one point however on which all farmers will agree and that is on the advantage and economy of keeping good bullocks instead of bad ones. With a view to facilitate the better breeding of cattle detailed enquiries have been made during the past year in the principal breeding tracts, and I think that the best method to proceed is as follows :—

In each well-marked breeding tract a small bull-breeding farm should be established ; to each bull-breeding farm a fodder supply depôt should be attached, on the lines already approved of, to serve as a local insurance against famine, and the fodder so stored will be earmarked for the cattle owners with whom we are directly working. Each such station will be in charge of a Manager part of whose duty it will be to keep in touch with the best local breeders and to organise small village cattle shows as an integral part of the operations that are undertaken. The breeds and localities that need to be taken in hand first are noted below :—

(1) For Mhaswad Khillaris of the Sangola-Man and adjoining tract, a station on the Nira Right Bank Canal now under construction.

(2) For Krishna Valley Cattle and Hanams of the South Sátára and North Belgaum tract, a station on the Krishna River, probably at Ainápur (Athni Táluka).

(3) For Tapti Khillaris of the Sátpuda tract, a station in the North of West Khándesh.

(4) For Mysore type of cattle of the Dhárwár District, a station in the Háveri Táluka.

Other localities and breeds might easily be suggested later on, but this programme will be quite sufficient for a start. As soon as the financial situation and the circumstances mentioned at the end of paragraph 2 permit, definite proposals for opening some such stations will be submitted and detailed suggestions regarding the issue of bulls and fodder and the exact line of work to be followed.

15. As regards the fodder storage scheme already sanctioned we were caught in Gujarát by a severe fodder scarcity in the first year, before we had any store of fodder available, and at Chharodi there was no grass to cut. We had sufficient reserve of grass to feed our own herd throughout the year and to allot a small quantity to the Collector of Ahmedabad for public use, but with regard to the scheme for storage on a large scale all that we were able to do was to erect a large fodder shed, to clear and smooth an additional area of grass land, to take the grass

cutting machines, and to provide ourselves with extra machines and field rakes. There is a good supply of grass this year and hay-making operations will be conducted on a large scale. At Nadiad too the same adverse conditions prevailed, and fodder could be grown successfully only under the farm well. This well is now being bored and a larger engine is being erected on it to provide for the recurrence of similar conditions. Prices of fodder ruled high and a stack of kadbi which cost Rs. 287-12-0 was sold for Rs. 440-8-0. This gives an idea of the rise of fodder prices in bad years.

At Kopargaon 40 acres of scrub land were cleared and broken up for the first time, and a fair crop of fodder was raised. The remaining 60 acres have since been broken up and are now under jowari. The shredding and baling plant which we ordered was sunk in the Mediterranean in the early part of the year, but a second plant has been supplied and now erected at the farm. All the kadbi on hand will be treated during the coming fair season, and the matter reported next year.

16. In growing fodder at Nadiad we came up against circumstances which are a grievous source of complaint to the Gujarát cultivators in many parts. In many of the larger towns there is a class of people who own no land but keep a number of cattle. Their method of feeding these cattle is to turn them loose every night to graze in the surrounding cultivated fields, and herds of such cattle may be seen leaving the town at night and returning to the town at dawn. Their depredations cause serious loss to the cultivators, and though the cattle which cause the loss and the owners of these cattle are well known, there is no effective way to stop the nuisance. The Cattle Pound Act is quite ineffective, for at night these cattle cannot be caught, and even if all the cultivators were content to forego their night's rest after their day's work, the only thing that they could do would be to keep the cattle moving from one field to another. The Nadiad Farm suffered serious loss from this cause, though the farm has a substantial fence and night watchmen were employed. Some of the stray cattle impaled themselves on our barbed wire and others died from eating immature jowari; but this did not save our crops from heavy damage. If it were made an offence to leave cattle loose between sunset and sunrise, and this regulation were applied to localities where this nuisance is serious, a remedy would be provided which the cultivators would greatly appreciate, and to which I think no fair-minded person could object. I have addressed the Commissioner, Northern Division, on the subject, and I understand that he is considering the question of approaching Government with a view to legislation.

CHAPTER IV.

Agricultural Education.

17. In May last the greater part of the buildings of the Agricultural College, consisting of the main block, the hostel, the block of servants' quarters and other minor details were handed over to the Military Authorities for use as a War Hospital. This naturally causes inconvenience to the staff and to the students, but adequate arrangements have been made, and the classes are now conducted in the laboratory block, and the students lodged in hired bungalows. The space now available is naturally very cramped, but the ordinary course is being given without any considerable diminution of efficiency. The only thing that we have had to drop for want of space is the annual practical course. Last year 27 students attended this short course, and the suspension of it has caused a drop in the number of students from 124 last year to 115 this year. The absence of the short course students is to a great extent made up for by the large number of new students who have joined the full course this year, namely 54, the largest number that we have yet had. It seems probable that the College will before long be filled to the extent of its capacity. The new syllabus is, I think, an improvement on the old one, and is likely to be popular.

18. The three Vernacular Agricultural Schools have had a successful year, and have fairly met the limited demand which exists for this kind of instruction. The buildings of the Jambul School are still under construction, but I hope that it will be opened before the beginning of next rains. As mentioned last year a new school was projected at Chopda (Khándesh). The people there had put up

the money for the purpose, a building and some land were provided, a master had been specially trained for the purpose, and there appeared to be good prospects of success. When the time came to open the school it was found that though the Chopda people approved of the idea in the abstract and were prepared to put up money for the purpose, nobody wanted to send his own sons to the school. The Deputy Director visited the place, and the head master of the Loni School was deputed for a time to help in starting the school ; but it soon became evident that the people concerned did not want the school, though many approved of the idea. The project was therefore abandoned and the masters withdrawn. If Chopda had been more accessible it would probably have been possible to push the matter through, and by patience to have won the confidence of the people and secured the students ; but under the circumstances this was not possible, and we had no alternative but to drop the idea. If I had not originally been given to understand that there was a very keen local demand for such a school I should certainly not have selected Chopda as a place to locate one. The result bears out an opinion which I had previously expressed that in the first instance such schools are likely to draw pupils only from families with whom the Agricultural Department has in some way established close relations.

The details of the working of the three schools during the year will be found in the Appendices. A Conference on the subject of Agricultural Education was held at Pusa during the past year, at which I expressed my detailed views on the subject of agricultural schools. I have also recently submitted to Government a note on the subject.

CHAPTER V.

Agricultural Engineering.

19. The difficulty and enhanced cost of obtaining machinery and engineering supplies of all kinds have made themselves felt during the past year and are likely to be more acute during the coming year. In spite of this, however, there is a successful year's work to record.

Well-boring.—In view of the defective rains in North Gujarát the great majority of our boring machines were transferred there to meet the insistent demand for well-boring that arose, and in this tract 215 bores were made of which 83½ per cent. were successful. In many cases the bore added to the well a quantity of water amounting to from three to five thousand gallons per hour. The most successful bores were—

(*a*) a 2½-inch bore in the Mehmadabad Táluka which added 7,000 gallons per hour to the well;

(*b*) a 3-inch bore in the Nadiad Táluka which added 7,000 gallons per hour to the well;

(*c*) a 6-inch bore in the Anand Táluka which raised the flow into the well from 1,000 to 16,000 gallons per hour.

The net result was an addition of nearly 400,000 gallons per hour to the wells of North Gujarát. These operations coupled with the erection of power pumping plants on a number of the bored wells have made a considerable difference to certain parts of North Gujarát. The extent to which cultivators resort to well irrigation varies greatly with the nature of the season, and it is therefore difficult to estimate the exact progress made, but the past season in North Gujarát was very similar to the season of 1911-12, both of them being remarkable for short rainfall and scarcity of fodder. A comparison of the areas irrigated from wells in the Kaira District for these two seasons gives the following results :—

1911-12	..	57,438 acres.
1915-16	...	62,029 ,,

showing an increase in the well-irrigated area of 4,591 acres. Without claiming any exactitude of the deduction I think that this increase may be fairly ascribed to the well-boring operations of the intervening four years in certain parts of the Kaira District.

20. An attempt is being made to chart the level of the sub-soil water in the Kaira District from the knowledge that we have acquired in these boring operations. The main deduction from this survey seems to be that the sub-soil water bearing stratum is anything but uniform in level, and rises and dips sharply even in small areas. It is therefore unlikely that the result of this survey will be of great practical utility, but it is none the less interesting; and any connection that we can establish between the level of the sub-soil water and other natural features will be of value. Outside Gujarát the most successful boring took place at Umbargaon in the north of the Thána District. This is particularly interesting since the tract has rich soil suitable for gardening, and if the irrigation facilities can be materially increased the proximity of Bombay should make market gardening in that tract a most profitable industry. Operations were extended to Khándesh and Sind without success, and the limited work that it was found possible to undertake in the Deccan tended to confirm the previous indication that the supply of water that can be expected from boring in the Deccan trap is uncertain and usually very limited, though it may serve as a useful addition to the existing percolation water in a well or may afford a useful supply for domestic purposes. This latter point is made clear by the bores taken from the surface at Deolali in the Násik District where many residents have secured a wholesome supply of drinking water at a small cost. The detailed statement appended by the Agricultural Engineer to Appendix J is of interest.

21. *Power Plants.*—The erection of power plants for the public for agricultural purposes continues, ten having been erected during the past year. Repairs were done in nine cases and advice given to many owners or prospective owners of agricultural machinery. Definite classes of instruction in engine driving are now being given at the workshop on the College Farm, and everything that is possible is being done to overcome the initial difficulties which must occur when unmechanical classes of people take to the use of machinery. The present high price of machinery and fuel oil tends to restrict the use of oil engines, but with a return to normal prices there must be a good future for developments of this kind in many parts of the Presidency.

22. *Steam Ploughing.*—Each of the steam ploughing plants worked at a small profit after paying all charges including depreciation and interest. In Gujarát during the year 1,203 acres of rough, virgin land were broken up to a depth of 1 foot, and the large clods harrowed down at a cost of Rs. 16 per acre. In the Dhárwár District 554 acres of grass-bound land were broken up to a depth of 16 inches at a cost of Rs. 25 per acre, and by way of extending the short working season a further area of 146 acres was subjected to shallow ploughing. There is a good demand for these operations at the charges made, and the organisation is improving. In Gujarát steam ploughing appears to be a sound business proposition, and this would also be the case, I believe, in the East Deccan where the rainy season is a very short one. In the Southern Marátha Country, however, it is more difficult to work at a profit owing mainly to the extended period of the rainfall which greatly reduces the length of the working season. For deep ploughing in these heavy soils it is probable that more powerful engines would be more economical, and this is a matter which we must bear in mind when we next invest in steam ploughing tackle. In all branches of Agricultural Engineering a strenuous year's work has been accomplished and steady progress maintained.

CHAPTER VI.

PROPAGANDA.

23. The following publications have been issued since those mentioned in last year's report:—

Bulletins.

No. 77.—Fodder crops of Western India.

No. 78.—Some wild fodder plants of the Bombay Presidency.

No. 79.—Cultivation of Guávas in Gujarát.

No. 80.—List of seeds available on the Agricultural College Farm, Poona.

No. 81.—Note on fencing construction.

Leaflets. (with vernacular versions).

No. 9 of 1915.—The Palm beetles.
No. 10 of 1915.—The use of crude night-soil as a Manure.
No. 11 of 1915.—Lucerne—A valuable green fodder.
No. 12 of 1915.—Lucerne fodder.
No. 13 of 1915.—Smut on Jowári and Rala.
No. 14 of 1915.—Treatment of a Mango plantation.
No. 1 of 1916.—The improved iron soil scraper or leveller.
No. 2 of 1916.—Poona gul boiling furnace.
No. 3 of 1916.—Sulphate of ammonia as a Manure for sugarcane.
No. 4 of 1916.—Rab substitutes and supplements.
No. 5 of 1916.—The I. N. D. and the Monsoon ploughs for North Gujarát.
No. 6 of 1916.—Artificial manures for tobacco in the Sátára District.

24. Seven agricultural Shows of some size took place, and 150 formal demonstrations. These are quite useful in their way if not repeated too often in the same locality, but it is probable that the most useful results are obtained by energetic members of the staff touring informally in the villages and advising individual cultivators on their own land. Much of such work is now done, and in some localities our staff is getting well into touch with the cultivators. Two successful shows were held at Pachora and Sindkheda by the Agricultural Associations at those places, and three held in Sind succeeded in interesting the Zamindars. In the south of the Presidency ploughing matches are becoming a popular adjunct to Agricultural Shows, and introduce the element of competition in a way that the cultivators can readily understand.

25. Four new Agricultural Associations came into existence, and one became defunct, leaving the total number of such Associations at 60. The Khándesh Táluka Associations, in which the Revenue Officials take an active part, continue to do useful work, and the Bijápur District Association now maintains a man of its own and sells improved implements on a large scale. At Athni and Kurtkoti some useful work was done by the local Associations, but I fear that many of the Associations remain in a state of suspended animation for most of the year, and that this must necessarily be so unless they are prepared to put up sufficient funds to pay for a man of their own, or unless some energetic member is prepared to devote a large part of his time to work of this nature. Even the Central Deccan Association suffers from lack of funds sufficient to engage a competent man of its own, but was fortunate during the past year in securing the honorary but energetic services of Mr. S. G. Paregaonkar, who toured extensively in several Deccan districts advocating agricultural progressed and trying to galvanise into life some of the moribund associations.

CHAPTER VII.

General.

26. A detailed statement of activity in many directions not noted on by me will be found in the Appendices; but I may mention that, generally speaking, I am of opinion that the utility of both our farms and our district staff to the public is steadily extending. In three directions the necessity for more concentrated study is clearly indicated, *viz.*:—plant breeding, soil physics and land development. Proposals for furthering these lines of work have been made, and as soon as it is possible, extended work of this nature will be undertaken.

27. In the matter of plant diseases the operations against grape mildew and the betel nut disease have been extended, and continue to find favour with the cultivators concerned. The campaign against smut on jowári has been vigorously pushed forward and some 40,000 anna packets of copper sulphate were sold departmentally. No doubt cultivators also obtained copper sulphate from other sources and used it for this purpose, and the Divisional Inspector of Agriculture,

Southern Division, is now able to report that in the Southern Marátha Country almost every cultivator has heard of this remedy.

28. The campaign against insects which attack field crops presents many difficulties. In many instances it can be shown that the hand-picking of caterpillars affords considerable relief at small cost, in some cases grasshoppers or beetles can be effectively swept up into nets and destroyed, and in other cases the destruction of moths round lights is fairly effective; by digging out white ants nests and destroying the queens damage can be greatly minimised, and in a few cases spraying against mites and aphis can be shown to be economical. No doubt much investigation still remains to be done regarding such remedies and the practical details of their application; but I fear that for a long time to come it will be very difficult to induce cultivators to adopt such measures of this nature as we are in a position to recommend. If such measures are to be successful they must be applied over a large area, at the right time and with thorough-going determination. In our small and interlaced holdings this involves a degree of co-operation which it is very difficult to secure amongst cultivators, many of whom object to taking life at all, and most of whom are apathetic regarding a pest which may possibly soon disappear of its own accord.

29. In conclusion I am glad to be able to state that a fair number of the staff are developing into capable and energetic workers, and this year I would select for favourable mention Mr. B. P. Wagholkar, Superintendent, Jalgaon Farm, and Mr. S. S. Salimath, Agricultural Overseer, Belgaum District.

I have the honour to be,

Sir,

Your most obedient servant,

G. F. KEATINGE,

Director of Agriculture.

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APPENDIX A.

REPORT OF THE AGRICULTURAL COLLEGE FOR THE YEAR 1915-16.

College Buildings.

1. The year under report is the eighth since the establishment of the College as a separate Institution. It has had the use of the whole of the new buildings, including the College hostel until April 1916. In March 1916, however, owing to the pressure on the space available for Military Hospitals, a request was made that the whole or part of the College Buildings should be handed over to the Military for use as a British War Hospital. After much consideration it was decided to carry on the College in the Chemistry block alone together with two lecture rooms in the main block of the College Buildings. This involved the handing over, for Hospital purposes, of the main College Building, the hostel and Superintendent's quarters, the bungalow of the Professor of Agriculture, and the quarters for College servants. Since this time the attempt is being made to maintain the work of the College in the buildings specified above, together with all the farm buildings and all the land not required by the Military for Hospital purposes.

2. The actual agreement with the military department was as follows:—

"(1) The Agricultural College will retain—

(*a*) the whole chemical block.
(*b*) the two lecture rooms on the ground floor of the main block.
(*c*) the farm office, the farm Superintendent's quarters and the quarters of his assistants.
(*d*) all other farm buildings except the quadrangle of farm servants' quarters.
(*e*) the bungalow of the Economic Botanist.

(2) The Agricultural College will hand over, for use as a War Hospital, if so required—

(*a*) the main block with the exception of the two lecture rooms mentioned in 1 (*b*).
(*b*) the college hostel and its out-houses including the quarters of the Superintendent of the hostel.
(*c*) the quadrangle of farm servants' quarters.
(*d*) the quarters of the resident Sub-Assistant Surgeon.
(*e*) the bungalow of the Professor of Agriculture.

(3) The military authorities will build near the bullock shed for the use of the farm servants, fifteen quarters and latrines for the same.

(2) The military authorities will provide the Professor of Agriculture with a bungalow in Kirkee.

(5) The land of the farm will remain in charge of the College but the military authorities may, in consultation with the Principal, erect any necessary structures on the land."

3. The transfer was made on May 6th, 1916. Since June 1st, when the College opened, work has been carried on in the restricted quarters. The chief, among many difficulties, has been the provision of quarters for the students in place of the hostel which has been given up.

Agricultural Courses.

4. The University Agricultural course, to which the main energy of the College is devoted had been subjected to much criticism from the old students, from some members of the staff, and, finally, from Sir Alfred Hopkinson who visited the College on behalf of the Bombay University in November 1913. As a result of these criticisms, the University appointed a Committee to make recommendations with regard to the future of the courses, consisting of the Principal of the College, Mr. G. F. Keatinge, Dr. W. Burns, and Rao Bahadur G. K. Kelkar. The report of this Committee was made in May 1915 and its recommendations were accepted by the University, and sanctioned by Government. The courses have been altered to a considerable extent. The second year's examination has been abolished, a certain amount of specialisation by students who wish to obtain the agricultural degree is required, and the course is made to fit more closely with the actual needs of students as tested during the past eight years. The new courses have been brought into use (except as regards the final year) in June 1916.

5. During the year the Bombay University has also created a new degree of Master in Agriculture to be given definitely for research in matters associated with agriculture.

6. The short course, started seven years ago, as an addition to the College work, is intended for farmers' and landholders' sons. For this the sole qualification is that the student knows English and has a fairly good general education. The training given is essentially practical, and is designed to give as good an acquaintance as possible with the best methods of Agriculture applicable to our areas. There was at first some doubt as to whether there was a real demand for this course, but this doubt has now entirely disappeared, and the number of students

has tended to increase and their quality to improve. The actual number of students attending the course has been as follows:—

1909-10	.. 4
1910-11	.. 12
1911-12	.. 13
1912-13	.. 15
1913-14	.. 15
1914-15	.. 22
1915-16	.. 28

For the year 1916-17 there would have been also a large entry, but when the main part of the College was handed over to the military, it became impossible to carry on this course. It was hence suspended, though it is hoped to resume it as soon as the opportunity occurs.

College Staff.

7. The Principal of the College was on privilege leave during April and May 1916 when Dr. Burns officiated for him. Professor J. B. Knight returned from leave in April 1916, and on his return Rao Bahadur G. K. Kelkar, who had acted for him, took leave preparatory to retirement. It is impossible to exaggerate the work done for the College and the Agricultural Department generally by Rao Bahadur G. K. Kelkar during his long connection with them. In his work at the college, he was recognised as a harder worker than almost any member of the staff, as a man of the highest character and principles, and as one absolutely devoted to the work he had undertaken. He was very highly respected and much beloved by the students and past students, and the distinction of *Rao Bahadur* granted to him during the year was highly welcomed by all connected with the college. By his researches into Indian Agricultural methods, and his efforts after improvement, the results of which are enshrined in numerous publications, he has laid agriculture in Western India under a deep debt of gratitude.

Mr. H. M. Chibber, M.A., Assistant Professor of Botany, was granted special leave in February 1916 to go to England to work at plant breeding questions under the guidance of Professor W. Bateson. His place was taken by Mr. G. B. Patwardhan, B.Sc., the Superintendent of the Ganeshkhind Botanical Gardens.

The position of Assistant Professor of Entomology and Zoology which has long been vacant was filled in February 1916 by the appointment of Mr. Ramrao S. Kasargode, L.Ag., to this position. The post of Lecturer in these subjects, which he had previously held, was at the same time abolished. Mr. Kasargode has fully deserved his promotion by his devotion to the subject in which he has conducted several important investigations particularly on the borer of rice, on the mango fruit fly, and on the borer of sugar cane, in recent years.

Mr. F. Gracias, G.B.V.C., Lecturer in Veterinary Science, was on privilege leave during April, May and June 1916. When the College reassembled on June 1st 1916, Mr. B. B. Joshi, G.B.V.C., Demonstrator in Veterinary Science, was appointed to act for him during the remainder of his leave.

The Superintendent of the College Farm, and Demonstrator in Agriculture, Mr. V. G. Gokhale, L.Ag., was transferred in 1915 to act as Extra Deputy Director of Agriculture in the Konkan, and Mr. K. V. Joshi, B.Ag., was appointed to act in his place. Mr. Gokhale has been exceedingly successful both as Manager of the College Farm and as Demonstrator in Agriculture. Very largely through his work and personality the College Farm has become an agricultural centre of great importance, and it is with great regret that the College loses his services.

Students.

8. The number of students in the new year (1916-17) is higher than in any previous session of the College, if we exclude the short course which is now suspended. The number of students in the first year for the first time exceeds fifty. The actual figures for the last seven years have been as follows:—

	1910.	1911.	1912.	1913.	1914.	1915.	1916, July
First year students ..	36	38	38	43	36	35	54
Second year students ..	33	24	27	25	31	29	23
Third year students ..	27	28	22	26	27	31	35
Short course students ..	12	13	15	15	22	27	not held.
Special and Post graduate students ..	2	1	2	1	1	2	3
	110	104	104	110	117	124	115

These figures will show the progress of the College. It would not seem, however, advisable in future years to have more than fifty students in the first year's class. The practical work cannot be carried on well if that number is exceeded, and it is proposed to restrict the admissions to that number in the future.

The students during the last five years included in the above table have come from the following parts of India :—

	1912.	1913.	1914.	1915.	1916.
Bombay Presidency — Deccan	2	28	23	20	14
Bombay Presidency — Southern Marátha Country and Konkan	25	29	38	45	44
Bombay Presidency — Gujarát	25	27	23	35	29
Bombay Presidency — Sind	6	4	8	7	9
Assam	..	..	..	1	1
Central Provinces	..	1	..	..	..
Central India	3	3	3	3	3
Nizám's Dominions	2	5	7	3	4
South India and Ceylon	14	11	12	7	6
Burma	1	1	..	1	2
United Provinces	..	1	2	2	3
Berar	..	..	1	..	..

Arranged according to the castes or classes from which they come, the students stand as follows :—

	1912.	1913.	1914.	1915.	1916.
Bráhmins	45	45	43	55	49
Maráthas	4	5	5	5	4
Lingayats	2	5	4	4	3
Patidars (Gujarát)	3	2	2	3	4
Mahomedans	10	10	7	12	10
Parsis	9	9	13	15	15
Europeans and Anglo-Indians	1	1	1	1	1
Others	30	33	32	29	29

9. These students may be divided into three classes :—

(a) By far the larger number are qualified to study for, and intend to take, the Agricultural degree of the Bombay University. The qualification on which the Bombay University insists, namely, the Previous Examination or its equivalent, is insisted on in the case of practically all students from the Bombay Presidency itself, and no student can, of course, appear for the University Agricultural Degree without it.

(b) The second class consists of a few students who are not admissible to the University Examination, but who are taking the regular course along with the first class of students. These exceptions arose from the fact that it has been decided by Government to allow scholars to be received from Sind who have only passed the Matriculation Examination, provided that they were to receive the same course, and pass by the same standard as the University demands. Under the ruling, students have been received every year since 1908. At the same time some applications were received from other Governments in India and Ceylon to be allowed to send students and from private persons outside the Presidency for admission to the College, where the applicants were not fully qualified for the University course. Where there was evidence to show that such students could properly follow the course a small number have been admitted as follows :—

	Admitted in 1912.	Admitted in 1913.	Admitted in 1914.	Admitted in 1915.	Admitted in 1916.
Nizám's Dominions	..	..	1	..	1
Sind	2	1	2	1	1
Bombay Presidency and Native States subordinate to it	..	..	2	2	5
Ceylon	5	..	..	..	1
United Provinces	..	1	1	..	2
Central India States	..	..	1	..	..
Coorg	..	..	..	..	1
Mangalore	..	..	..	..	1

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(*c*) In the third place we have the short course students already referred to. The place from which they came in 1915-16 were as follows :—

Deccan	.. 5
Southern Marátha Country and Konkan	.. 4
Gujarát	.. 9
Nizám's Dominions	.. 3
South India and Ceylon	.. 4
Central India	.. 1
Sind	.. 1

As has already been stated, this course has been closed in 1916-17.

10. In addition to these classes, we are being occasionally requested to undertake the training of men for special purposes. We have admitted in 1916 a young man training for botanical work under the Department of Agriculture, Burma. We have also now a man taking a special course for ultimate work in Burma, and also another doing higher botanical work under Dr. Burns. We have also had two men working at the Chemistry of Foods in the laboratory of the Agricultural Chemist.

University and other Examinations.

11. At the University Agricultural Examinations held in 1916 the number of candidates shown in the following list were presented with results as indicated :—

	Sent up.	Passed.	Failed.	Percentage of passes.
First Examination in Agriculture ..	31	20	11	64·5
Second Examination in Agriculture ..	23	23	*Nil.*	100·0
Bachelor of Agriculture Examination ..	29	23	6	79·3

A special College Examination of the students (referred to above) not entitled to take the University Examination was held in March 1916 with the following results :—

	Presented.	Passed.	Failed.
First Examination in Agriculture ..	2	1	1
Second Examination in Agriculture ..	5	5	*Nil.*
Final Examination for Diploma in Agriculture ..	2	2	*Nil.*

12. The number of students who passed through the regular course at the College and succeeded in obtaining the University Degree or the College Diploma (which is of the same standard and represents the same character of man) is as follows during the past eight years :—

Year.	Degree.		College Diploma.		Total.	
	Entered.	Passed.	Entered.	Passed.	Entered.	Passed.
1909	34	26	....	....	34	26
1910	39	36	....	....	39	36
1911	22	20	5	5	27	25
1912	27	22	1	1	28	23
1913	19	14	4	3	23	17
1914	23	18	3	3	26	21
1915	21	20	6	5	27	25
1916	29	23	2	2	31	25

I think it may be taken that in future the number who appear in the Final Agricultural Examination will be about twenty-five to thirty each year, and the number of graduates about twenty-five.

SCHOLARSHIPS.

13. The number of scholarships offered by Government at this College is now fifteen per annum. Candidates must have passed the Previous Examination of the Bombay University or obtain the certificate from the Principal of an Arts College, which the Bombay University now accepts instead of that examination, and are selected by the Director of Agriculture in consultation with the Principal of the College. They are given by preference to the sons of cultivators and are awarded for the three years occupied by the course. The Director of Agriculture is empowered to extend the tenure of the scholarships to four years, and give a limited number to Matriculates, who afterwards will join this College, for study in an Arts College. During the last six years scholarships have been awarded to candidates from the various districts as follows :—

	1911.	1912.	1913.	1914.	1915.	1916.
Deccan ..	5	6	2	2	..	3
Southern Marátha Country ..	3	2	3	4	5	5
Gujarát ..	6	..	2	4	2	2
Konkan ..	1	..	1	5	6	3

14. The students from Sind are on a different basis. They are appointed by the Commissioner in Sind, and are not required to have passed the Previo us Examination in every case. We have now at the College two such scholars from Sind in the fi rst year, two in the second year and three in the third year.

15. Other Governments and the public bodies have utilised the College for the training of scholars. The number so admitted since 1911 has been as follows :—

DATE OF ENTRY.

	1911.	1912.	1913.	1914.	1915.	1916.
Baroda Government	..	2	..	..	1	..
Sángli State	..	..	1	..	..	..
Aundh State	..	..	..	..	1	..
Jamkhandi State	..	1	1	..	..	..
Porbandar State ..	1	..	..	..	..	..
Kotah State ..	1	..	..	..	..	..
Vithalgadh State ..	1	..	..	..	..	..
Jámnagar State ..	1	..	..	..	..	..
Lingáyat Education Fund ..	..	..	2	..	..	..
Ceylon Government	..	4	..	..	..	..
Bánsda State	..	1	..	..	..	..
Rájpipla State	..	..	2	..	..	..
Junágadh State	..	..	1	..	..	3
Dewás State	..	..	..	1	..	..
Indore State	..	..	..	1	..	1
Mysore	..	..	..	1	..	..
Burma	..	..	..	..	..	1

LIBRARY.

16. The growth of the College Library is very satisfactory. Nine years ago it did not exist. On the separation from the College of Science being completed, a number of books (chiefly old and out-of-date) on Agriculture, Botany, and Veterinary Science were handed over to us and formed a nucleus for the future. A special grant of Rs. 6,000 per annum was made in 1909 for library purposes, and was continued during the two following years. Since that time the annual grant has been Rs. 2,500. With the funds thus made available and a number of presentations of books, the library has rapidly increased. The number of books in it at the end of the last eight years has been as follows :—

1908-09	.. 1,182
1909-10	.. 2,780
1910-11	.. 4,000
1911-12	.. 5,040
1912-13	.. 5,943
1913-14	.. 6,840
1914-15	.. 7,638
1915-16	.. 8,390

It is fairly consulted, not only by College students, but by gentlemen from all parts of the Presidency, and every effort is made to make it increasingly useful to the public.

College Quarters.

17. The College quarters completed during 1914-15 have proved themselves excellent in every way and have been excellently managed by the Superintendent Mr. D. L. Sahasrabuddhe, B.Sc., L.Ag. Almost all the students stayed in them during the year 1915-16, and they will accommodate practically the whole of the present attendance at the College.

18. The transference of the College buildings to the military department for use as a hospital in May 1916 involved the transference of the hostel and its attached buildings. This made it necessary to accommodate the students elsewhere in the neighbourhood of the College. The old quarters belonging to the College near the Boat Club at Kirkee, which have been used for the last two years for emergencies, have been again fully occupied. Beyond this, bungalows have been taken to accommodate the remainder at a cost of Rs. 478 to adapt them for our use, and at annual rental of Rs. 3,180. The arrangement is inconvenient, but can be made to answer until our own hostel is again available.

Employment of Graduates.

19. The demand for agricultural graduates is increasing, and there seems now little trouble in placing the good men. As I write I have several applications in hand for men, to fill which I have difficulty in finding satisfactory candidates. Of the past students of the regular three years' course who have been employed or arranged for during the year, the direction of activity is as follows:—

Bombay Agricultural Department	..	5
Bombay Irrigation Department	..	1
Ceylon Agricultural Department	..	1
Private employers (non-agricultural)	..	3
Employed on their own land or in connection with industries depending on agricultures	..	6
Native State Service	..	4
Unknown	..	5

College Dairy.

20. During the year the Government Civil Dairy at Kirkee has been under the control of the College and the Manager of the Dairy is Assistant Professor of Dairying. This has been used for several years as a teaching centre for dairying for the students, and in future it will be available in greater measure than hitherto, as this is now recognized as one of its primary functions.

Veterinary Dispensary.

21. The District Veterinary Dispensary at Bhámburda has been carried on as a College Dispensary during the year. Charge of the dispensary was in the hands of Mr. F. Gracias, G.B.V.C., assisted by Mr. B. B. Joshi, G.B.V.C., as Resident Veterinary Officer. During the year there has been a distinct increase in the number of patients. A total of 1,643 animals were treated (as against 1,458 in the previous year), of which 387 were in-patients and 1,256 were out-patients. The daily average attendance of in-patients was 15·1 and of out-patients 19·8. Of those treated, 825 were agricultural animals. Out of the 1,643 cases, 852 were treated free. Among contagious diseases, there were thirteen cases of suspected rabies in dogs, of which six proved to be rabid. Thirteen cases of foot and mouth disease were treated in connection with outbreaks at surrounding villages. No other cases of infectious disease came to the notice of the dispensary staff in the year under report. The dispensary staff have now, however, been given charge of the Haveli táluka and Mulshi petha of the Poona district for epidemic work. The police have continued to take advantage of the dispensary for carrying out post mortems in medico-legal cases. The Deputy Superintendent, Civil Veterinary Department, inspected the dispensary in December 1915.

Other Matters.

22. A course in Arboriculture for subordinates of the Public Works Department was undertaken for the second time in January and February 1916 and was attended by fourteen men. The organization of the course was entirely in the hands of Dr. W. Burns and the instruction was actually given by Mr. H. P. Paranjpe, B.A., Assistant Economic Botanist. The success of the course was entirely due to the enthusiastic work of these officers. The men who attended it were accommodated in the College hostel.

23. The College was inspected by a committee on behalf of the Bombay University on July 29th, 1915. The report of this committee is already before Government.

24. The staff have worked well, and are doing a considerable amount of research, and also of demonstration work in addition to their own duties. I may repeat what I said last year that the College tends to become every year more and more of a centre for activity in connection with agricultural improvement and the dissemination of agricultural information. It has hence been visited by a constantly increasing number of landlords and other interested gentlemen on the one hand, and on the other by large crowds of cultivators. For nearly two months in September and October 1915 large parties were brought almost daily to the College farm under arrangements suggested by the Commissioner of the Central Division. Every effort is made to stimulate the public interest, as it is felt that the permanent success of the institution must largely depend on the extent to which it can be maintained.

HAROLD H. MANN,
Principal.

APPENDIX B.

REPORT OF THE MARATHI AGRICULTURAL SCHOOL, LONI, POONA, FOR 1915-16.

The Marathi agricultural school at Loni has now passed beyond the stage of experiment. It will be remembered that it was established in Poona in 1910 as an agricultural boarding school, the object of which was to give a thoroughly practical training to boys, who belonged to good substantial cultivating and land-owning families, whose object in life was to cultivate or manage their own lands. The course is one of two years for boys by preference between the ages of 14 and 17, who have at least passed the fourth Marathi standard. It is under the supervision of the Principal of the Agricultural College, but is quite independent of the College, with an experienced agricultural graduate as headmaster.

2. The school was removed to Loni, to land and buildings specially prepared for it, in November 1913, and has been carried on there since that time. In laying out the school at Loni, an attempt was made to make the whole property as much like a substantial cultivator's holding as possible. The area is twenty-nine acres and is practically entirely worked by the boys. It contains land suitable for cultivation with and without irrigation, and a small fruit plantation has been laid out. A portion is irrigated by means of a small oil engine, which every boy has to learn to drive himself. The school and residential buildings are laid out like a large village *wada*, and the whole place is really a self-contained agricultural centre. To the buildings a sick room and a small gymnasium have been added during the last year, the former by the generosity of the Sir Sassoon David Trustees, and the latter by contributions from the parents of boys either formerly or at present in the school.

3. The boys at present in the school number thirty-seven derived from the Marathi speaking districts as follows :—

	1st year.	2nd year.
Poona ..	..	2
Sátára ..	1	..
Ahmednagar ..	3	1
Násik ..	2	8
East Khándesh ..	3	3
Thána ..	1	..
Ratnágiri ..	..	3
Belgaum ..	..	1
Kolhápur State ..	2	1
Ichalkaranji State ..	..	1
Savantvadi State ..	1	..
Berar ..	2	1
Central Provinces ..	1	..

4. Arranged according to caste the boys stand as follows :—

	1st year.	2nd year.
Maráthas ..	10	8
Mális ..	..	1
Gujarátis ..	..	2
Bráhmins ..	6	10

Those admitted are carefully selected from a much larger list, and only those who are genuine cultivators or landowners who intend to work their land are as far as possible admitted.

5. Mr. K. M. Pawar, B.Ag., has been headmaster during the greater part of the year : he was transferred to take charge of a new school at Chopda in May 1916, but returned on that school not becoming a running institution. In his absence his place was taken by Mr. V. B. Parbhune, B.Ag., Mr. Pawar has now returned and is showing his accustomed energy. During the year Mr. G. G. Pundlik was taken for training with a view to utilise him later at another agricultural school ; he left in November 1915. Since that time Mr. V. B. Parbhune was trained and has now been transferred to Jambul to take charge of another school there.

6. The school has been supported by a number of district local boards, and during the six years the school has been in existence the following subsidies have been received :—

	1910-11.	1911-12.	1912-13.	1913-14.	1914-15.	1915-16.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
West Khándesh ..	..	..	..	..	..	54
East Khándesh ..	200	200	72	..	72	216
Poona ..	225	..	720	..	..	792
Násik ..	250	250	216	288	..	788
Ratnágiri ..	250	..	216	..	..	144
Sátára ..	..	116	432	504	288	72
Sholápur ..	..	50	420	504	288	72
Ahmednagar ..	..	100	..	840	72	144
Thána ..	..	..	72	144	72	..
Bijápur ..	..	..	72	..	..	..
Kolába ..	..	..	72	..	..	..
Belgaum ..	..	..	..	72	144	72

The trustees of the Sir Sassoon David Trust have for the third time made a grant of Rs. 750 to the school, being the whole cost of the training of five boys. Our thanks are due to the generous donors of these amounts.

7. The curriculum has been very slightly modified during the year, but on the whole has been quite successful. It involves, as I explained in last year's report, at least half the working time being spent in farm work, or in gardening, in dairying, or in other agricultural operations. The boys do practically all the work on the land allotted to their use, and they have almost entirely produced the food, and fodder, except the grain and pulse, used in the school. The school work more properly so called consists of arithmetic, more especially including farm accounts on the one hand, and mensuration applied to agricultural purposes on the other; nature study largely taught practically; writing and reading; geography of India especially in relation to crops; the principles of agriculture; and two new subjects (1) 'village life' including sanitation, hygiene, and secondary occupations suitable for villages; and (2) what we call 'citizenship,' which includes question of how to obtain money by *takavi*, by co-operative credit, or by other methods, and in addition, the system of local and village Government in this part of India.

8. The number of applications for admission to the school has been considerably greater than we can take, but a careful selection was made, and admission is only granted to those who are themselves cultivators, or who are small landowners where the boys are intended to devote their life to work in connection with land. The course is moreover a hard and practical one, and unless a boy is ready to work on the land at what some consider menial occupations he does not want to stop, and so there is considerable leakage at first. It is, I feel, nevertheless essential to maintain this tone if the school is to serve the purpose for which it is intended. I am sorry to note that the number of applications for admission this year has been smaller than usual, but I hope this is only a temporary decline.

9. The school has been frequently visited by ruling chiefs, by officers of Government, and by many of the parents and friends of the boys. A good metalled road to the school is now complete, and a visit will be easier in the future than it has been in the past, at any rate during the rains.

10. At the end of the school year in April 1916, the boys were examined by Messrs. D. L. Sahasrabuddhe of the Agricultural College and V. K. Kogekar, Divisional Inspector of Agriculture, and as a result twenty-one certificates were granted to boys who had completed their two years' training. The examiners made remarks as follows :—

I. "I examined the students of the Vernacular Agricultural School at Loni in Arithmetic, Nature study, Surveying and Marathi and am glad to say that they have all done well. They are well up in Arithmetic, fairly good in Nature study and Surveying but not quite so good in Marathi. The students are all careful and neat in their work."—(*D. L. Sahasrabuddhe.*)

II. "I examined the students of the Loni School in Agriculture (theory and practical) Agricultural Geography, Secondary occupation and Essay writing and beg to offer the following remarks.

"The boys have done very well in the subjects of Agriculture, Geography, and Secondary occupation and in answering the above papers have shown that they possess power of reasoning and good deal of practical general information. The essay writing showed powers of thought and arrangement of the subject while expressing the same.

"The starting of the carpentry and smithy classes has greatly added to the practical side of the school and it is gratifying to note that the boys are able to repair the broken parts of implements and prepare new parts such as coulters, handles, rings, pins, blades, *khurpis*, etc., very nicely. They are well up in practical work and handle all the implements cleverly. They however require more training as regards the more common diseases of cattle, especially of young stock. The curriculum in this respect is rather meagre. It is suggested that arrangements may be made for the visit of the veterinary Assistant at least once in a fortnight to give the necessary lessons in this subject to the students.

"The tone of the school has been maintained to the highest pitch. The boys are well disciplined, hardy and have a manifest liking for field work."—(*V. K. Kogekar.*)

11. Eighty-one boys have now completed the course and been granted certificates. Most of these are farming on their own or on other land. We are keeping as far as possible in touch with them, and it is hoped they will become centres of influence in the future. We held a reunion of old students before the vacation in April, which was attended by Prof. J. B. Knight and by Mr. P. C. Patil, Deputy Director of Agriculture. A very large number came and recounted their experiences which were on the whole of a very encouraging character. The school is increasing too in local influence, and is now established as an implement depôt under the Agricultural Department.

12. The accounts of the school are shown in the following statement.

Receipts.	Rs.	a.	p.	Expenses.	Rs.	a.	p.
1. Poona Treasury (Government grant)..	8,780	0	7	1. Establishment ..	2,250	5	0
2. Local Board Grants ..	2,354	0	0	2. Boarding charges ..	3,235	8	10
3. Grant from Sir Sassoon David Trust Fund.	750	0	0	3. Purchase of live stock ..	248	0	0
4. Sale-proceeds, etc. ..	525	1	9	4. Cultivation Charges, Purchase of carts, etc.	969	4	6
5. Hire of Ploughs ..	225	1	0	5. Feeding of stock ..	600	0	0
				6. Draining, levelling and making garden.	82	0	9
				7. Conservancy charges ..	155	0	0
				8. School furniture and books	7	2	0
				9. Postage charges ..	30	0	0
				10. Travelling allowance and tours.	349	7	6
				11. Running of workshop and Oil Engine.	372	15	3
				12. Irrigation charges ..	92	2	0
				13. Remitted to the Treasury	3,104	2	9
				14. Miscellaneous office expenses.	388	2	9
				Total ..	11,884	3	4
				Balance ..	750	0	0
Total ..	12,634	3	4	Total ..	12,634	3	4

HAROLD H. MANN,

Principal, Poona Agricultural College.

APPENDIX C.

WORK DONE UNDER THE DEPUTY DIRECTOR OF AGRICULTURE, NORTHERN DIVISION, DURING 1915-16.

1. I took up charge in September 1915 and continued during the remaining part of the year. There is very little change of work on the existing Farms except on the Nadiad Farm During the year under report a Fodder Farm is opened and is being developed at Kopergaon (district Ahmednagar). Buildings are put up and oil engine, shredder, baler and other machinery are being erected. A small plot for trying experiments on sugarcane and garden crops is opened at Amalsad (district Surat). Both these are brought under good working order. A small plot is also opened at Kopergaon to investigate problems underlying sugarcane cultivation on the Godawari Canal. The Agricultural Station at Nadiad which was an experimental station is converted into a fodder growing Farm and all the experiments on tobacco, etc., are discontinued. During the year under report the season for north Guzerát was not a favourable one and no appreciable results were obtained in growing different kinds of fodder.

Due to the frequent change of the District Agricultural Overseer, Poona, the work in this district suffered a little, but elsewhere things have been improved materially. There was only a non-graduate fieldman in charge of Násik District, while Kaira and Panch Maháls were not supplied with Agricultural Overseers. By reorganizing the staff, we have been able to put each district under a graduate fieldman. Besides, the appointment of Sugarcane Expert with his two non-graduate fieldmen have strengthened the district staff on the canals in Nagar and Násik districts. The staff for canal area will have to be increased further when it is proposed to extend activities on the new Canals, *i.e.*, Pravara and Nira Canals.

Cottons.

2. This division includes two big tracts under two different types of cotton. The two Khándesh districts and parts of Ahmednagar and Násik districts growing Khándesh cottons (Neglectum type), while Broach and Surat districts growing Guzerát cottons (Herbacium types). The work on Khándesh cotton is well organized having got two seed Farms (*viz.*, one at Dhulia in West Khándesh and one at Jalgaon in East Khándesh with an area of 28 acres 30 gunthás and 204 acres 31 gunthás, respectively), and as many as 40 seed plots with total area of 870 acres. The Farms are managed entirely by the officers of the Department, while the seed plots are managed by the owners of the plots under the advice and supervision of the Department. The co-operation between the owners of the seed plots and the officers of the Department is satisfactory and cordial. During the year under review 56,877 lbs. of N. R. cotton seed were produced on the Jalgaon and Dhulia Farms and seed from this stock was supplied to the seed growers for sowing 889 acres 24 gunthás. The produce of the seed Farms was satisfactory. 99,534 lbs. of seed was purchased from the seed growers by the Department for distribution. The demand for seed was keen. Besides the produce of Jalgaon and Dhulia Farms and the purchase of 99,534 lbs. from the seed growers, 40,401 lbs. of last year's seed which was in stock was also sold. The ginning percentage of the type distributed was satisfactory and the lint always fetched better prices. At Dhulia the Farm lint of N. R. cotton was sold in two lots at Rs. 70-2-0 and Rs. 73-12-0 per 240 lbs. when the market rate was Rs. 61 and Rs. 65 respectively. Also at Jalgaon the lint realized better prices. The Farm lint was sold at Rs. 77-2-0 per palla when the price prevailing in the market on that day was Rs. 67 only. The Department has extended its field of operations in this connection in the cotton growing tálukas of Nagar and Násik districts with good results.

3. Selection of N. R. cotton is continued at Dhulia and Jalgaon. The promising cross between Comilla and Bani is grown at Dhulia and kept under observation. Four samples of this cross were sent for valuation and the Imperial Cotton Specialist got them valued from Messrs. Tata Sons and Co. The valuation is as under :—

No.	Name of Cotton.	Valuation in Rs. per Candy of 784 lbs.	Number of counts to which it can be spun.	Remarks.
	Comilla × *Bani*.			
1	Boll IV 5^{2a} (1911-12) ..	350	32 s.	First stands No. 1, then comes No. 3, then No. 4, and last No. 2. All have woolly characteristics of Assami cotton in them. No. 1 has improved by cross, having in it fine staple of Hinganghat.
2	Boll II 3^{12} (1913-14) ..	305	20-24 s.	
3	Boll X 1′ (1912-13) ..	330	28 s.	
4	Boll XI $6^{2''}$ (1913-14) ..	325	28 s.	

4. A few bolls of the new cross Bani × N. R. has been obtained on the Dhulia Farm. This will be further continued.

Guzerat Cottons.

Surat District.

5. The scheme adopted last year was followed this year as well and the followng quantities of seed were distributed :—

No.	Name of the Village and Group.	Variety of Seed.	Quantity of seed distributed.		Area sown.		Remarks.
	Group I.		Mds.	Srs.	A.	G.	
1	Athwa and Majura ..	1018 P/G ..	44	30	113	8	Some 250 acres were sown with the Farm seed in Navapur peta of the West Khándesh District.
2	Bhatar ..	Selection I A ..	35	0	115	22	
3	Althan ..	1027 A L F ..	37	20	87	8	
4	Bharthana ..	Selection I A ..	86	0	198	11	
5	Piplod ..	Selection II ..	58	20	157	7	
6	Umra ..	Do. ..	42	10	107	25	
			304	0	775	1	,
	Group II.						
	Mohini, Khambasla, Deladwa Kharwasa.	Sania Seed ..	378	20	729	27	
		Total ..	*682	20	1,504	28	*Equal to 25,916 lbs.

The cultivators of the second group gave a little trouble in the beginning at the time of handing over their kapas to the committee as they did not receive money in advance. The firm of Messrs. Narandas Rajaram and Co. came to the help of the Committee and advanced about Rs. 28,000 to cultivators. Mr. Bhimbhai, the Divisional Inspector of Agriculture, N. D., was unfortunately ill when these transactions took place, and the Ag. Divisional Inspector managed the affairs. The lint was sold in 5 sales as follows :—

No.	Date of contract.	Quantity of seed cotton contracted for.			Lint obtained.		Seed obtained.			Amount realised by way of sale of lint and seed.			Rate per Bhar of Farm Cotton.			Rate per Bhar of local cotton on the day of contract.			Quantity of Kapas required to make up one candy of lint as ascertained from gin.			
																			Farm Kapas.		Local Cotton.	
		Bhs.	Mds.	Srs.	Mds.	Srs.	Gls.	Md.	Srs.	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.	Mds.	Srs.	Mds.	Srs.
1	10-2-16	75	2	30	598	29	40	4	1	10,355	7	1	138	0	0	129	0	0	63	8	64	20
2	23-2-16	139	17	15	1,119	38	75	14	11	19,622	2	3	140	5	0	131	0	0	62	39	65	0
3	1-3-16	78	21	25	635	5	40	0	0	11,086	9	6	140	8	0	131	0	0	62	24	65	0
4	11-3-16	100	3	35	796	28	53	3	25	13,902	6	3	138	12	0	129	0	0	63	15	66	0
5	7-4-16	85	5	25	658	13	46	1	5	11,496	4	9	135	0	0	129	0	0	63	29	66	0

Bhrs. = bhars.
Mds. = maunds.
Srs. = seers.
Gls. = gallies.

38½ lbs. = one maund.
24 maunds = one bhar (924 lbs).
One candy = 784 lbs.
One gally = 30 maunds.

The seed was sold separately. The total sum realized and distributed to the cultivators after deducting expenses of ginning, etc., amounted to Rs. 66,462-11-9. The ginning percentage of the produce from the Farm seed has shown superiority over that of local cotton as will be seen from the last two columns of the statement above. These transactions show that the cultivators of both these groups made a profit of Rs. 9 per bhar by growing the Farm cotton. The Divisional Inspector of Agriculture, N. D., reports that the introduction of the Farm seed on a larger scale in preference to the local seed will depend much upon the co-operation of the Revenue Department as the persuasion of the officers of the Revenue Department to take up this seed will be more effective. During the season 1916-17, 25,935 lbs. of seed have been distributed and the result of the next year's transactions will be watched.

This year the firm of Narandas Rajaram and Co. did not send any bales of the Farm kapas to Liverpool for valuation as they were advised by their friends in Liverpool that owing to the abnormally high rate of freight (about 125*s.* against 35*s.* of last year) and the further charges in connection with War risk insurance, the rate realized in Liverpool for Indian cotton would be no criterion of comparison with rates of Americans. The firm however intimates that the mills, whom this cotton was supplied, report that the quantity of this year's crop was on the whole satisfactory except the last lot. It will thus be seen that our cottons are no doubt superior in quality to local cotton.

6. On the Surat Farm, seed of last year's selected plants of cottons was sown in the year under report for continuing the work of selection. Of these "Selection I" was left out as it has not been found superior in any way to "Selection II" and "Selection I A." The ginning percentage of Selection I A in plot 344 has reached to 40·6. The following statement gives the yield and ginning percentages and valuation by Messrs. Tata Sons and Co., Bombay, of these cottons.

No.	Variety of Cotton.	Yield per acre in lbs. (average).	Ginning percentage.		Valuation by Messrs. Tata Sons & Co., Bombay.		Remarks.
			Selected.	General.	Valuation in Rs. per candy of 784 lbs.	Counts to which it can be spun.	
	Surat Farm.						
1	Surtee Local ..	172	....	33·7	345	30 s.	Local cotton for comparison. This is rather mixed.
2	Selection I A ..	206·0	40·6	38·3	360	32 s.	Even running good staple cotton better than No. 1.
3	Selection II ..	201·8	36·4	36·6	325	24 s.	Very irregular having long and short fibres mixed. There is some staple better than No. 2.
4	1027 A. L. F. II ..	170·0	36·4	36·3	355	30 s.	Staple irregular.
	Sisodra Plot.						
1	Navsari Local ..	....	....	31·5	290	20 s.	This has greatly deteriorated, is very irregular and not the length of Navsari staple. It does not possess the silkiness of the Navsari, it is a lint bit better than Broach.
2	1027 A. L. F. II ..	....	....	32·0	350	28 s.	It is inferior to the cross grown at Surat.
3	Selection ..	....	....	34·1	325	24 s.	Almost alike Surat grown.
4	Selection I A ..	....	....	33·1	355	32	Compared with No. 2 (Surat) it seems to be rather irregular, long and short fibre mixed.

Basis of valuation of Surti cotton on 21st June 1916 was Rs. 360 per candy. The figures of yield in the above statement are from the area planted at the disposal of the Cotton Supervisor for comparing the strains. But on the farm where larger area was sown selection I A has yielded 325 lbs., selection II 238·7, and 1027 A. L. F. II has yielded 352·7 lbs. per acre.

The samples were not sent for taking spinning tests as one year's selection would not be a definite guide. This selection work will be continued till the object aimed at, *viz.*, to increase the ginning percentage, is achieved.

Broach District.

7. The plot at Bori (district Broach) was given up from 1916-17 as a larger plot at Broach has now been rented. On the Broach Farm four types isolated last year were carefully gone through as regards the evenness in size and shape of bolls. It has been observed that type 'A' is more even than 'B' and 'C,' while type 'D' is reported to be most uneven. The selection in each type was carried out and the results regarding yield and ginning percentage are tabulated below :—

Variety of Cotton.	Yield per acre in lbs.	Ginning percentage.
Ghoghari A ..	246·2	44·5
Do. B ..	227·5	44·5
Do. C ..	250·0	44·5

8. Samples of A, B and C types of Ghoghari were sent for valuation to Messrs. Tata & Sons through the Imperial Cotton Specialist and they are tabulated below :—

Name.	Remarks by Messrs. Tata Sons and Co.
Broach Deshi	Is equal to ordinary fine Broach. We value at Rs. 280. Can spin upto 20 s.
Large round bolled Ghoghari A type Large long bolled Ghoghari B type Small round bolled Ghoghari C type	These are all short staple weak fibre cotton re sembling Bengal; in no way they can be compared with Broach. We value them at Rs. 225. Can spin upto 10 s.

Basis of valuation (on 21st June 1916)—
Broach Fine Rs. 285 per candy of 784 lbs.
Bengal Fine „ 230 do.

9. The crosses referred to in paragraph 18 of last year's summary were made during the year under report and 12 bolls were obtained in both the ways, *viz.*, Ghoghari A type × Bani, and Bani × Ghoghari A type. This work will be continued.

Kaira and Panch Mahâls.

10. Owing to the scarcity of rainfall in Northern Gujarát during the year under report cotton experiments on the Nadiad Farm did not give any definite results. As the introduction of the best type of Ghoghari seed in these two districts will be facilitated by the progress on the Broach Farm where different types of Ghoghari are selected, the experiments on cotton on the Nadiad Farm have been discontinued from the year 1916-17.

11. In Dohad and Jhalod tálukas N. R. cotton has been selected for introduction and for the season 1916-17, 1,200 lbs. of N. R. cotton seed of the produce of the Dohad Farm have been distributed. On the Dohad Farm the average outturn per acre during the year under report was 682 lbs. of seed cotton. Separate district staff for the Panch Mahâls district has been appointed from 1916-17 and the result of the extension of area under this crop will be carefully watched.

Ahmedabad District.

12. No special work regarding cotton crop seems to have been done in this district which is a great cotton growing area. It is proposed to send the senior Cotton Supervisor to this district next season both to study the cotton trade as well as to make a survey of the cotton in the district. Further lines of work will depend upon this survey.

Sugarcane.

13. This can be divided into four sections—

(*a*) The work under the Sugarcane Expert on Canals.
(*b*) Work on bandharas and wells in the Násik district.
(*c*) Work at Amalsad (Surat district).
(*d*) Work at Kasandra (Ahmedabad district).

(*a*) Work under the Sugarcane Expert on the Canals.—Since last year a special agricultural officer (Sugarcane Expert) is appointed to look after canal areas in the Deccan. At present his work is confined to Godawari, Pravara, Girna and Jamda Canals. A large number of Poona and Saswad Farmers have hired lands on Godawari Canal. These people, though they know sugarcane cultivation very well, care for immediate profits without caring for the future of the land. The local people knowing practically nothing of sugarcane follow careless and time serving methods, and it is feared that unless things are mended in time the lands will be spoiled and careless cultivation will be introduced in this newly opened tract. The Department therefore has plenty of work, and our efforts are much appreciated by the local people. We are moreover trying to develop this tract by opening implement and manure depôts and encouraging co-operation. There are several local questions to be solved and a small experimental plot is opened at Kopergaon. It is however found necessary to extend the work and it is proposed to open another larger plot at Savalvihir. At present we are trying varietal and cultural experiments mainly. On stiff clay soils which do not grow Pundia cane, the standing crop of Khadya planted 3' apart is thriving well. This must however be confirmed by further experience. Three different methods of planting are being tried here—local method, modified West Indies method and Java method. The results will appear in the next year's report.

As a result of our activities, advisory and demonstrational, the farmers on Jamda and Girna Canals are getting more confidence and extending their areas under sugarcane. In the year 1912-13 I could not see even a single acre of sugarcane on the Girna Canal. In the year 1915-16 when the Sugarcane Expert was appointed there were nearly 30 acres under sugarcane. His activities have raised this area to 97 acres in 1916-17. The farmers are steadily going in for concentrated manures.

(*b*) Work on the bandharas and wells in the Násik district.—Work on bandharas is commenced before six years. It is under the Divisional Inspector of Agriculture, Central Division. Here we induce the people to follow better cultivation, apply concentrated manures and adopt iron mills (instead of wooden mills) and Poona furnaces and pans (in place of the local waste fuel furnaces). This work was carried on as usual. Sugarcane industry on the bandharas in the Násik district, it can be claimed, is infinitely improved by the Departmental activities during the last six years.

(*c*) and (*d*) Work at Amalsad and Kasandra.—Cultivation of sugarcane as well as cane crushing and gul making in Gujarát is far backward. In the southern tálukas of the Surat district red rot is very virulent. The Departmental work at Amalsad and Kasandra promises well and we hope to help the people in improving the cultivation of cane and the manufacture of gul. We also expect to give them a better variety of cane and more economical gul making furnace. Mr. Batliwalla of Kasandra, on whose estate we try experiments, crushed 14½ acres sugarcane by power crusher and made gul on improved furnaces under Departmental supervision. He was thoroughly satisfied with the results.

Wheat.

14. The comparative trials with several varieties of soft and hard wheats have been continued on the Dohad Farm during the year under report with the result that the conclusions arrived at in the past regarding the suitability of soft wheat for brown soil and the superiority of Pissi over other varieties are confirmed. Pusa No. 4 was also tried for comparison with Pissi and the former has been found inferior to the latter.

This will be tried further. The selection on wheat in Gujarát was duplicated at Nadiad and Dohad in the past. Since the Nadiad Farm is changed into a fodder Farm, wheat work on that Farm is entirely transferred to Dohad Farm. The set of selections at Dohad was poor and badly affected with rust, and hence the work is continued with the Nadiad set.

Jowar.

15. The trials to compare pedigree seed with Bazar seed were continued on the Surat Farm. The results obtained last year regarding the superiority of pedigree seed in the case of Chapti and Perio varieties are confirmed. Selection work with this crop at Surat has been continued.

Rice.

16. Jiresal, Kamod and Sutarsal varieties of rice were tried on the Dohad Farm. The results of the trial are highly satisfactory.—Jiresal yielding the highest, *viz.*, 2,837 lbs. paddy per acre.

Groundnuts.

17. We have distributed groundnuts in Khándesh during the past seven years and it has become one of the popular rotation crops in the district. Plenty of seed is now available with the farmers. Moreover due to the War, most of the last year's outturn had not gone out but was available in the district. However 21,951 lbs. of groundnut seed were distributed in Khándesh and 10,000 lbs. supplied to Dhrángadra State. The farmers themselves sell their seed to their neighbours. It will be seen from the following statement how the area under groundnut is extended year by year in the Khándesh districts.

Name of District.	During the year				
	1911-12.	1912-13.	1913-14.	1914-15.	1915-16.
East Khándesh ..	2,002	2,794	3,573	4,224	8,149
West Khándesh ..	1,017	1,325	2,564	2,063	2,782

In the Nagar district the plots at Vadala and Shevgaon have become centres for extending groundnut cultivation in that district as will be seen from the acreage noted below.

Year.	Area in acres in Táluka.					
	Newasa.		Pathardi.		Sheogaon.	
	A.	G.	A.	G.	A.	G.
1913-14 ..	15	25	52	39	6	0
1914-15 ..	92	0	118	15	7	0
1915-16 ..	243	0	383	0	68	0

In Dohad táluka of the Panch Mahâls district where this crop has been successfully grown, 233 lbs. of seed were distributed during the year under report.

Other Crops.

18. The work of isolating and selection in maize and gram at Dohad is in progress.

Breeding Herd at Surat.

19. The strength of the herd on 1st April 1916 was 94 of all classes as against 88 on the same date in 1915. The total quantity of milk produced during the year was 63,576 lbs. as against 60,472 lbs. in 1915. This quantity was yielded during the year by 30 cows. The average annual yield per cow therefore works 2,119 lbs. The practice of converting the balance of milk remaining unsold into ghee had been continued, but it appears that if customers for the disposal of the whole quantity be found out, there will be a greater profit than by converting the unsold quantity into ghee. It is therefore arranged to sell some quantity of milk at concession rates to some Charitable Institutions such as the Parsi Orphanage, Vanita Vishram, etc. The results will be watched.

The selection of the young bulls for breeding was continued. The following table shows the distribution of bulls for breeding in the past.

No.	Name of Bull.	Year in which sold.	Selling price.
			Rs.
1	Tonti ..	14th March 1914 ..	150
2	Goru ..	Do. ..	150
3	Laxman ..	Do. ..	150
4	Lallu ..	Do. ..	90
5	Budhio ..	6th March 1914 ..	125
6	Manar ..	16th June 1914 ..	500
7	Jaglo ..	15th December 1915 .	150
8	Ramo ..	10th August 1916 ..	150

During the year under report calves worth Rs. 308 were sold.

The financial condition of the herd is satisfactory. There is a net profit of Rs. 71-4-3 in the working of the dairy. This profit is arrived at by calculating the price of foodstuffs at market rates. If the price of the foodstuffs be calculated at the cost at which they were raised on the Farm, the net profit would amount to Rs. 1,251-8-9.

So far only the quantities of milk given by each cow were measured. This gives the total quantity of milk each cow gives in a year but does not give definite idea as to how much butter fat she would make. Recently Gurber's fat-tester is purchased and arrangements are made to analyze milk of every cow (once a fortnight). This with the milk records will give us better data to judge the cows. It is also proposed to keep at least two bulls—we have got one and one more will be purchased from outside—and divide the herd of cows and try to attempt selection for pedigree bulls.

Milk Industry of Kaira District.

20. It is a very important subsidiary industry of the Farmers in Gujárat. In Kaira district alone over 1,71,988 buffaloes are kept by the farmers and over 22,937 lbs. of separated and 6,804 lbs. of whole milk, 69,068 lbs. cream, 15,097 lbs. mava, etc., are sent out of the district by train. Rough survey of this important industry in Kaira is made and the question is being studied with a view to suggest improvements.

Palms (Surat District).

21. There are large numbers of Palmyra and date palms in Surat district numbering about 2 lacs of former and 5 lacs of the latter. The date palms are tapped for toddy but the palmyras are not made use of. With a view to see if these palmyra palms can be made any use of, this question is taken up for investigation. Palmyra palms are mostly found in Olpád, Chorási, Mándvi and Bárdoli tálukas. There are 23,500 in Olpad, 22,000 in Chorási, 10,000 in Mándvi and 9,000 in Bárdoli táluka. After ascertaining particular villages where such trees are concentrated it will be seen if these trees can be tapped for gul making.

Dry Farming Experiments at Nagar.

22. The area under these experiments was reduced to 15 acres and the area belonging to the Agricultural Association was given up. A new series of bunded, levelled and terraced plots was laid up with a view to see whether moisture conserved by this process would increase the outturn. An area of two acres was bunded and levelled and four plots of 20 gunthás each were prepared. The cost of levelling and bunding came to Rs. 76 per acre. There was a total rainfall of 33 inches 12 cents during the year but on the whole it was irregularly distributed. As this is the first year of these experiments no conclusions can be drawn. The experiments will be continued and the results will be watched.

CROP PESTS.

23. *North-West Locust.*—Swarms of locusts appeared in some villages of Viramgam, Prantij and Modasa Talukas in the North Gujarát and in some of the Native States. In the last week of June information about their laying eggs was received and the Entomological Assistant tried to find out egg masses at their halting places in Gujarát, but they could not be traced. In the year under report no hatching of hoppers was reported from any place.

24. *Mites.*—During the year under report mites on jowar appeared in Jalalpur Taluka of Surat District during the long breaks in the rains in the month of August and September, but before the pest could spread to any extent it rained and this checked its future progress. A jowar plot of about 2 acres 9 gunthás at Abrahma village in Jalalpur Taluka was sprayed with lime and sulphur as soon as the pest made its appearance. This timely spraying aided by the climatic change checked the pest. The financial results of the spraying are given in the following statement :—

Area in	Treatment.	Yield per acre in lbs.		Value of produce per acre in Rs.	Cost of spraying per acre. *	Remarks.
		Grain.	Kirbi.			
A. G.				Rs. a. p.	Rs. a. p.	
2 27	Two sprayings of lime and sulphur.	748	243	35 2 4	1 15 10	The spraying was given as soon as the disease appeared slightly.
2 27	No spraying ..	673	224	31 10 4	..	The plot had a slight attack of mites in the beginning.

* Details of expenses for the whole plot—

	Rs. a. p.
13 lbs. sulphur	.. 3 4 0
13 lbs. lime	.. 0 5 0
1½ lbs. salt	.. 0 0 6
1½ lbs. soap	.. 0 4 0
Labour for spraying, 12 men at 2 annas each	.. 1 8 0
	5 5 6

25. *Mango Hoppers.*—These are small sucking insects which live and breed on mango and appear in great numbers at times. During the year under report this disease appeared in Bulsar Taluka ; and owing to the cloudy and damp weather these insects increased to a great extent. Spraying with Incosopal was tried. It was not found very effective.

26. *Termites.*—White ants are very troublesome in light Goradu soil of North Gujarát. At Kasandra and Visalpur in Ahmedabad District some 235 ant hills were dug out and propagating queens numbering about 65 found in these nests were removed. The cost of digging these nests came to about Rs. 50. Apart from the damage caused by these insects in fields they cause great ravages in cotton and cloth godowns. A successful effort was made to treat the godowns of the New Sherrocks Spinning and Weaving Mill at Nadiad measuring 110′ × 40′ of katcha ground floor. The floor was dug out to a depth of 8″ to 10″ and the earth was soaked with a solution of sodium arsenate. The solution of sodium arsenate was prepared of the following strength :—

1 lb. white arsenic.
4 lbs. washing soda.
2 gallons water.

It has been found after one year that no termites were able to come up through the soaked floor and hence the goods in the godowns were not damaged at all. The cost of these operations came to Rs. 20-1-6.

27. *Katra.*—Katra was very serious in the Dohad and Jhalod Talukas of the Panch Mahals District. This pest was controlled on the Dohad Farm by bagging and hand picking. About 84 lbs. of Katra caterpillars were killed in this way.

28. *Stored Seed.*—During the year under report fairly large quantities of grain stored for seed was fumigated with carbon bisulphide. The following statement shows the different kinds of seeds fumigated at different places :—

No.	Name of the District.	Kind of Seed in lbs.			
		Wheat.	Jowar.	Paddy.	Pulses.
1	Kaira ..	....	....	3,160	....
2	Broach ..	520	11,440	1,340	....
3	Surat ..	480	3,280	2,160	160

29. *Steeping against smut.*—During the year under report the following number of copper sulphate packets were sold to the cultivators as noted against each district for steeping jowar against smut :—

Ahmedabad ..	960	West Khándesh ..	3,096
Broach ..	321	Násik ..	60
Surat ..	524	Nagar ..	266
East Khándesh ..	1,077	Poona ..	151

Implement Depôts.

30. In addition to the depôts mentioned in the last year's report 5 more depôts have been opened. The following statement shows the hire charges realized during the year at each depôt :—

	Rs. a. p.		Rs. a. p.
Poona District—		Khándesh Districts—	
Hadapsar ..	176 12 0	Shirpur ..	10 12 0
Loni ..	225 1 0	Dondaicha ..	22 3 0
Baramati ..	38 1 6	Dhulia Farm ..	50 13 0
Peth ..	2 ½ 0	Jalgaon ..	9 7 0
Mandangaon ..	104 10 0	Amalner ..	22 4 5
College Farm ..	167 3 0	Chalisgaon ..	4 14 0
Ahmednagar District—		Depôts on Canals—	
Shevgaon ..	50 15 0	Kopargaon ..	175 6 6
Vadala ..	76 0 0	Pohegaon ..	144 5 6
Pimpalgaon pissá ..	40 2 0	Pimplas ..	193 5 0
Nagar Farm ..	25 2 0	Kanalad ..	178 13 6
Násik District—		Ojhar ..	29 10 0
Malegaon ...	118 13 0	Brahmangaon ..	5 7 0

From the above it will be seen that these depôts are doing very useful work by way of popularising and introducing improved implements.

31. The management of some of these depôts is in the hands of private individuals and it is hoped that the Agricultural Associations and Co-operative Societies might run such depôts in future as an integral part of their operations. Special mention may be made of Mr. Farate, who ably managed the depôt at Mandangaon. He alone sold 59 iron ploughs worth Rs. 2,207. Most of these were purchased by himself independently and sold without making any profit.

32. In addition to keeping implements for hire, a stock of implements, on consignment stock account on behalf of several firms, has been kept and the total number of implements sold and the amounts realized at these depôts is given in the following statement :—

Kind of Implement.	No.	Amount.	Kind of Implement.	No.	Amount.
		Rs.			Rs.
CT2 ploughs ..	49	2,342	Pans ..	8	520
BT2 „ ..	6	245	Chatanorga Mills ..	5	1,155
Sabul „ ..	6	270	Mhots (iron) ..	41	531
Arlington „ ..	19	812	Hand hoes ..	7	120
Kirloskar „ ..	21	819	Scraper ..	3	51
I. N. D. „ ..	5	133	Chaff Cutter ..	2	28
Monsoon „ ..	21	506	Spare parts ..	..	193
Chains for „ ..	28	109			

Arrangements have also been made to stock spare parts of implements at almost every depôt by which arrangement the difficulty of replacing broken parts is removed.

In the depôts on the Canals along with the implements manures are also kept for sale to cane-growing cultivators. During the year under report a large quantity of ammonium sulphate and cakes was sold at these depôts.

33. In the North Gujarát a demand for light iron ploughs is created. During this year 26 I. N. D. and monsoon ploughs worth Rs. 639-7-0 were sold to cultivators. It is proposed to open some more depôts in Gujarát if funds permit.

Implements and Machinery.

34. I have, under the heading of Implement Depôts, described how the introduction of improved implements is becoming popular. The implements most popular are iron ploughs, iron-mhots, iron sugarcane mills, etc.

35. *The Bajac and Gallows ploughs.*—The Bajac and Gallows ploughs are found very useful in cleaning foul lands but such work is slow and expensive. We have in the past years to undergo some loss on Bajac work though we charge at Rs. 30 per acre, since we had to maintain teams and operators. During the year under report one of the ploughs was brought to Khándesh and to minimize loss, the system of hiring was changed. Instead of keeping teams departmentally only the plough (with one operator) was let out at Rs. 3 a day. The average ploughing per day (in Khándesh) was 9 gunthás only and though the cultivators extremely like the work they find the cost heavy since they have to supply bullocks and to pay about Rs. 14 per acre.

36. *Chatanooga Sugarcane Mill.*—It is a new mill in the market and is a promising one. The trials taken show that it is superior to Poona iron mills.

No.	Mill.	Village.	Weight of Cane.	Weight of Juice.	Percentage extraction.	Time required.		Time required per 1,000 cane.	
			Lbs.	Lbs.		Hours.	min.	Hours.	min.
1	Chatnooga ..	Pohegaon ..	1,683	1,242	73·8	2	45	1	38
2	Bari ..	,, ..	1,870	1,242	66·4	3	9	1	41
3	Chatnooga ..	,, ..	1,683	1,242	73·8	3	0	1	46¾
4	Bari ..	,, ..	1,683	1,112	66·1	2	45	1	38
5	Chatnooga ..	,, ..	1,695	1,242	73·3	2	46	1	37¾
6	Bari ..	,, ..	1,695	1,101	65·0	2	50	1	37¾

The mills are in demand and about 5 are supplied on requisition.

37. *Thresher.*—A thresher was sent by Messrs. Duncan, Stratton and Co., Bombay, for trial (details will be found in the Jalgaon Report of 1915-16), but it was not found useful.

38. *Avery's Rotary Harrow.*—It was thought that it would collect weeds in Gorádu soils if used after ploughing. It was not found to do this work effectively. It however does good work by way of mixing manures in the soil.

39. *Clipper Drill.*—The use of the clipper drill for sowing wheat was demonstrated in the Násik District on several estates. The germination was even and crop uniform. The work is much liked by the cultivators in the Násik District.

Agricultural Schools.

40. When Rao Saheb G. V. Joglekar was Deputy Collector of Northern Division, East Khándesh, he had proposed to open an Agricultural School at Chopda and had made provision for it by way of raising a fund and enlisting annual subscribers from Chopda Taluka. At the request of Rao Saheb Joglekar as President of the Chopda Agricultural Association, Agricultural Department promised to give them a graduate paying his expenses and one was trained for this purpose. The people of Chopda did not show keen desire for such a school. Moreover at such a time the Deputy Collector and the Mamlatdar who had negotiated with us for Chopda people and initiated the scheme were transferred. The idea therefore had to be dropped. It will however be a good thing if a well-equipped Agricultural School be opened for both Khándeshes at Jalgaon where we have a good farm, practically run on commercial basis. The Taluka Agricultural Associations at Jalgaon, Bhusawal, Amalner, Chopda, Pachora and the District Agricultural Association at Jalgaon have decent funds at their disposal to help the scheme.

The idea of opening an Agricultural School at Godhra had to be abandoned as funds could not be made available due to the War.

Shows and Demonstrations.

41. During the year under report 2 agricultural shows and 19 demonstrations were held in this division as noted in the margin.

No.	Place.	Date.
	Deccan.	
	Ahmednagar District.	
1	Ashur ..	6th & 7th December 1915.
2	Ahmednagar ..	26th to 28th December 1915.
3	Kopargaon ..	1st to 3rd March 1916.
4	Dhor Chandgaon ..	15th March 1916.
5	Kukana ..	23rd March 1916.
	Násik District.	
6	Dindori ..	28th November 1915.
7	Vadala Bhori ..	5th March 1916.
8	Bhutane ..	5th March 1916.
	West Khándesh District.	
9	Sindkheda ..	20th to 22nd January 1916.
10	Shirpur ..	20th February 1916.
11	Ner ..	26th April 1915.
12	Kusumba ..	2nd May 1916.
	East Khándesh District.	
13	Shendurni ..	10th October 1915.
14	Pachora (Demonstration) ..	18th October 1915.
15	Shirsoli ..	24th October 1915.
16	Pachora (Show) ..	29th to 31st January 1916.
	Gujrat.	
	Surat District.	
17	Venkanar ..	20th February 1916.
	Broach District.	
18	Bhersum ..	10th January 1916.
19	Sarbhon ..	5th February 1916.
	Panch Mahâls District.	
20	Dohad Farm ..	19th September 1915.
	Ahmedabad District.	
21	Kasandra ..	5th March 1916.

The shows at Pachora and Sindkheda were grand and equally useful. The demonstrations were managed economically. However they were well attended and as usual they served useful purposes. These shows and demonstrations bring us in close touch with the farmers and the Revenue Officers and facilitate our work and enable the farmers to reap the advantages that can be got from our Department.

42. *Gul-making.*—Besides this, a large number of gul-making demonstrations were given in Nagar and Násik Districts. The list of such demonstrations will be too long at this place. We built furnaces, supplied iron mills and pans, besides the advisory and practical teaching work. During the last 6 years we have in fact revolutionized the old sugarcane growing and gul-making in Násik and Nagar Districts, though in the latter district this work was unintentionally helped since 1914 by cane planters from Poona side who have gone there.

The gul demonstration, at Kasandra (near Ahmedabad) where Poona furnace as well as the multiple furnace was worked in connection with the power crusher, was much appreciated by the farmers round about.

43. Ploughing and other demonstrations showing the actual work and explaining the advantages of these have become one of the routines of the Agricultural Overseers. Olpad wheat thresher was demonstrated in several places in Khándeshes.

P. C. PATIL,
Acting Deputy Director of Agriculture,
Northern Division, Poona.

Poona, 12th September 1916.

APPENDIX D.

WORK DONE UNDER THE DEPUTY DIRECTOR OF AGRICULTURE, SOUTHERN DIVISION, DHA'RWA'R, DURING 1915-16.

STAFF.

Mr. T. Gilbert was absent on privilege leave from August 11th, 1915, to November 11th, 1915, and during this period Ráo Saheb M. L. Kulkarni acted as Deputy Director of Agriculture, Southern Division. Mr. S. V. Shevade was on privilege leave for three months and Mr. G. R. Deshpande acted in his place. A few other officers enjoyed short periods of leave. The only addition to the staff has been a graduate who is undergoing a training on the Dhárwár Farm.

One of the fieldman sanctioned under Government Resolution No. 226, Financial Department, dated 18th January 1915, has nearly completed training at the Gokak Canal Farm, and the first refusal of his services has been offered to the Committee, Prince Albert Victor Fund, Chikodi. Another man has been trained on the same farm on behalf of the Bijápur Agricultural Association, and he has recently taken over charge of the Association's farm. The graduate fieldman who formerly assisted the Cotton Supervisor has been transferred to general farm work, and his place has been taken by a non-graduate acting in the vacancy caused by the transfer of one of the staff to the steam-plough. The Cotton Supervisor is now in charge of cotton, wheat and jowar breeding and selection.

Both the Bhilawádi and Bársi plots have been closed. The former gave negative information as the result of introducing new cottons, and was no longer wanted as a centre for the use of copper sulphate for pickling jowar seed. The latter had contributed a little information about jowar varieties of Sholápur District, and had been a useful demonstration centre for implements. Bársi Táluka is moving ahead very fast in the adoption of iron implements, and though a depôt would find customers there, the services of the Overseer in charge were required elsewhere. He has been transferred to clerical duties at Sholápur. The Overseer, Bhilwadi plot, has been transferred to Koregaon, and from this centre he will control the field experiment and demonstration work in the north and north-east Tálukas of Sátára District.

GENERAL.

Under this head several subjects for enquiry were mentioned last year—a report on cattle-breeding with special reference to the Khillári cattle of west Sholápur was sent in—and no further information has been collected. Information and several diagrams have been collected regarding systems of land reclamation practised by black soil cultivators and some experimental work is in progress at Dhárwár and at Gokak. Further enquiry has been made, and a little experimental work done with reference to rice cultivation, and a note is now under compilation.

Pig-proof wire fencing is in keen demand in spite of high prices. Two miles of Titan-woven wire fence and $\frac{3}{4}$ mile of pig-netting fence have been or are being erected. One fence at Kelgeri on the Dhárwár-Goa Frontier road, one at Amblikop, Dhárwár Táluka, and one near Háveri station are in good places to attract public notice. Both wire and teak wood posts are very expensive. A note on fencing construction has been sent for publication. Several miles of fence are on order.

An enquiry regarding the outturn of gul on canals in the Sátára District is in progress.

All figures available with the Belgaum Military Dairy for yields of Sindhi cows and of buffaloes were examined. The buffalo is probably a slightly heavier yielder of milk and consequently a much heavier yielder of butter fat.

The relative efficiency of various sugarcane mills is being studied.

The future development of the Dhárwár Experiment Station has been under consideration. Several experiments have led to conclusions which are being published as bulletin and are summarised at the close of this report, and other experiments are likely to work themselves out. Plant-breeding and the establishment of selected strains of crops has been severely handicapped by shortage of space, and it is very seldom that there has been area available to test thoroughly a strain believed to possess the desired characters. A comparison of two single plots will not measure differences less than 20 per cent*. If two varieties are compared by alternating five plots of each, the measurable difference is reduced to about 9 per cent. The five alternating plots system has been adopted previously in a few cases on the Dhárwár farm, and in future, now that area is becoming available, is to be adopted for all varietal comparisons. A selected strain will be tested accurately and in a comparatively short time, and if it is profitable variety, can be multiplied and advertised and, if unprofitable, rejected. At the same time as becoming a seed farm, the Dhárwár farm is developing rapidly as an advertising and distributing centre for iron implements.

* Wood and Stratton, Journal of Agriculture, Section III, page 439.

Implements.

The gross value Rs. 26,340* of implements sold, compared with Rs. 6,000 last year, and Rs. 4,000 the year before, affords a good testimonial to the system of supply outlined in last year's report and to the method of advertisement by demonstration. The Agricultural Association's magazine publishes a price list every month. The Chatanooga sugarcane mill and the hand groundnut sheller are useful new machines. The last reduces the cost of shelling by ½ and more, and the breakage of nuts is much less, than when the shells are removed by beating with a stick. An excellent, substantially built copy of the machine is being made by Mr. Tikekar of Sholápur and costs Rs. 65 whereas the original cost Rs. 176-2-9. Quotations for a similar machine with blower have been received recently. The Olpad wheat thresher is being manufactured by village carpenters in Bijápur and Dhárwár Districts more cheaply than the farm workshop can turn them out. However, if the cultivator wants a good strong machine whose iron discs will not bend, he will do well to buy a farm made implement. Power chaff cutters are in use on the Gokak and Dhárwár farms and are doing good work, and will no doubt effect a great saving in fodder. The use of the stone roller for threshing jowari is extending.

Implements worth Rs. 2,413 were stocked for hire and realised Rs. 602, or 24·9 per cent gross. Even allowing a liberal figure of 15 per cent. for repairs and depreciation, there is a wide margin for profit. The Athni Agricultural Association recovered Rs. 140 as hire for implements worth Rs. 300.

The Dhárwár farm workshop accounts opened with manufactured stock on hand worth Rs. 304-6-9 and unmanufactured stock worth Rs. 187-3-0. The workshop now sells its manufactured stock immediately on completion, to the depôt, and book-sales amounted to Rs. 1,056-4-1 and cash sales to Rs. 873-4-3. The accounts closed with Rs. 250-11-9 worth of unmanufactured stock on hand, and showed a profit of Rs. 80-4-8.

Shows, Demonstrations and Competitions.

Demonstrations of implements have, in parts of the country notably along the Don Valley in Bijápur District and in parts of Sholápur and Sátára Districts, been followed by so wide an adoption of a suitable tool that demonstrations solely for the purpose of advertising that tool are not wanted. For this reason the ploughing competition, given passing mention in last year's report, has been instituted. The cultivator does not understand competition when it takes the form of show of produce, but he thoroughly appreciates a competition in which he and his bullocks are actively engaged. Draft rules for competition have been published in the Kánarese magazine; they were tested this year and found satisfactory.

General farm demonstrations were held at Gokak and at Dhárwár. The attendance at Dhárwár was only 99 compared with 1,000 the year before. This shows that an annual farm demonstration is not wanted; once in 5 years would probably be quite enough. The demonstration at Gokak was attended by 300 people, and was much appreciated. District demonstrations numbered 53. The Veterinary Department were asked to combine as often as possible, and to demonstrate early castration of bull calves.

Apart from active demonstrations, numerous demonstration plots of manures, cultivation and crops exist. The cultivation of sugarcane on the channel system worked out at Mánjri is becoming popular in Sholápur. Seventy acres have been planted. Lucerne has proved itself a most useful crop in Sangola Táluka, and those who have grown it reject the customary cake for feeding their stock. This crop in other places succumbs to Rhizoctonia, which necessitates replanting comparatively frequently—it is a new crop in Sangola, and this point has not yet been tested.

Silage pits have been dug at various places. There is much to be learnt on the subject, and it is very easy to prepare manure by mistake. Very good silage, yielding 60 per cent. by weight of the fodder put in the pit, was made at the Gokak farm from maize. During filling, a solution of milk sugar was sprinkled on each layer of the fodder. Fair silage was made from maize stalks after green cobs had been removed and sold, and in places where there is a market for unripe cobs, this is probably a good way of dealing with the crop.

The Poona method of gul-making is approved, and immediately adopted in some places, while in others the people prefer their own system. The furnace and pan and method of boiling used in north-west Belgaum District turn out gul much more quickly than the Poona system; and colour may not count for much, where a hard gul of good keeping quality is wanted. The professional gul-makers of south-west Belgaum are adopting the Poona design of furnace for their own pan.

Some detailed experimental work done on the Gokak Canal Farm shows that the best system for north-west Belgaum is probably a combination of Poona furnace, local pan and local method. The Poona furnace saves about Rs. 15 worth of fuel and time per acre when trash is used—a further investigation is necessary with other fuels.

* This figure includes those sold by the Bijápur Agricultural Association.

The use of copper sulphate for pickling jowar is shown on every opportunity. 37,000 packets were sold.

Magazine.

The Dhárwár Agricultural Association's magazine, the Vakkaligaru and Vakkaltanavu, has a circulation of 1,800 copies. Its tendency is to publish too many articles descriptive of shows and other functions, and not enough instructive articles. There is also a tendency for some contributors on special subjects, to leave their subject for some agricultural side issue about which they know nothing, and to give faulty information. The editors must be careful to eliminate, say from an article on a veterinary subject, any diversion which discusses a point on which the author is not likely to be an authority. Instructive articles with diagrams and illustrations wherever possible want encouraging, and the printers want to give attention to the careful reproduction of diagrams.

Vernacular Agricultural School, Devi-hosur.

The school is developing on the lines indicated in last year's report. The age limit qualifying for admission has been increased to 18 years, and may have to be extended further. Boys who have passed the 3rd rural standard are admitted. The main difficulty in running a school of this type is to secure a regular attendance—parents almost invariably support a boy's application for leave of absence, and excuse his absence without leave. Hardly a single weekly attendance roll shows a complete list.

Fifteen boys attended the second year class and ten new boys came in June 1915. One boy, who had already attended the Loni school, left before completion of the course. One boy died of plague. The fifteen senior boys were 12 Lingayats, 2 Brahmins, 1 Kurubar; the new boys 6 Lingayats, 3 Brahmins, 1 Raddi.

The school was closed for one month from 6th January 1916 to 6th February 1916 on account of plague and the term was extended until 15th May 1916. All candidates, except one, passed the final examination.

Arrangements for regular medical attendance were made, and the Sub-Assistant Surgeon, Haveri, pays weekly visits to the school.

The farm is to be extended to include some rice land, and for this the school is once more indebted to Ráo Saheb Shetti. A well is being dug, and a workshop is under construction. A bore hole in the compound gives regular and ample water-supply for drinking.

Acknowledgments are due to :—

(1) Sir David Sassoon Fund.

(2) Lingayat Education Committee.

for contributions of Rs. 1,750 and 240 respectively towards expenses, and to Messrs. G. A. Hiremath, A. B. Modak and V. R. Dharwarkar for presentation of prizes.

Tegur Farm.

The stock have increased to 20 cows, 2 heifers, 12 bull-calves, 25 cow-calves. A new stud bull has been purchased, and will replace the old one shortly. The old bull is not a first class specimen of his kind, is aging rapidly, and spends most of his time away from the herd. Two young bullocks about one year old have been taken to the Dhárwár farm, and are being stall fed. The mortality amongst young calves upto one week old was heavy, and the reason is not apparent.

Hay and silage are still far from all that can be desired. Hay-making from spear grass must always be difficult because the grass matures too early. A late grass (or grasses), which matures at a time when there is little chance of hay-making being interrupted by rain, is wanted, and amongst the 34 varieties of grasses and leguminosæ grown on small plots, there are several promising kinds. Chappargyan hullu (Thelepogon Elegans) is a fairly late annual of medium tall habit, a good fodder grass, and will be sown on about 4 or 5 acres next year. Seed of other good varieties, annual and perennial, is being multiplied, and there should be enough seed to make up test mixtures in 1917-18.

Agricultural Associations.

The Bijápur Association is the only District Agricultural Association in this division that has proved that it really means business. It has sold Rs. 7,347 worth of implements, has had a gardener trained at the Gokak Canal Farm, and has another man in training at Poona. This Association is canvassing selected men from each Táluka, and hopes to organise an annual competition open to members only. Of the smaller Associations Athni is doing well, Kurtkoti again held a successful demonstration, but its organizers seem not to be prompted by the spirit of Association. Hungund has not advertised its existence of late. A new association at Hubli have opened an implement depôt. A few men at Sangoli in Sampgaon Táluka put up Rs. 200 for the purchase of ploughs, and this is no doubt the right way for an association to start. None of the others have started with a definite object in view, they usually have a paper cheme undertaking all sorts of Agricultural propaganda, talk about and vary the scheme at each meeting, and go no further.

Cotton.

The area under Cambodia cotton is extending, and record prices were realised this year at the auction. The length of staple is unfortunately decreasing. The area under Broach cotton has decreased, but the crop will probably hold its own in a few places.

It is time now to give up hope that either of these cottons will reform the cultivation in a large tract of country: the chances that any cotton will spread to the extent that Dhárwár-American has done are very small, and future work will aim at producing and maintaining various selected strains from which the grower can make his choice. Seed for a few acres of two good strains is going out near Dhárwár during coming season.

Neglectum Roseum has done well in various parts of the Sholápur District, and with proper organisation for seed supply will probably spread.

The breeding and selection work is showing very distinct signs of progress—an inspection of the Dhárwár farm plots shortly before harvest reveals a number of young strains distinct from each other, but themselves uniform in habit and in character of cotton. Kumpta cross 1340, 10-5-1, 1914-15 was valued equal to Navasári. The hairy-leafed type in Dhárwár-American is probably a heavier yielder, and more resistant to red leaf disease than the smooth types. For the latter reason a note was published in Ranebennur Táluka warning cultivators against the use of Gadag seed—the smooth type of plant is practically non-existent at Ranebennur. Of newly imported American varieties, none are likely to be of much use, but some are being preserved in case they are wanted for crossing work.

Other crops will be discussed in a future report.

Some Experimental Results.

(Figures for profit or loss are relative to the net profits derived from control plots expressed as zero.)

Bulky Manures.—An average of six years' results shows an advantage of 7 per acre in favour of poudrette, of 5 in favour of farmyard manure and of town sweeping, and a loss of 3 against rotted cactus. Five tons per acre of each were used. The control received no manure.

Cake Manures.—Six years' figures show an average loss of Re. 1 to Rs. 6 per acre per annum from safflower, karanj and castor cakes, and crushed cotton seed. The dressing of each contained 20 lbs. nitrogen per acre.

Nitrogenous Manures.—All plots received a common dressing of 2 tons farmyard manure per acre once in two years. Nitrate of soda, nitrate of lime, ammonium sulphate, calcium cyanamide and nitre have resulted during six years in average losses ranging from Re. 1 to Rs. 4 per acre. The control plot received no manure other than the common dressing, the manured plots received 10 lbs. of nitrogen per acre, and one plot receiving 10 lbs. of nitrogen as farm manure gave an average profit of Rs. 3.

An experiment comparing during eight years the effects of giving (*a*) 2 tons farmyard manure, to jowar, (*b*) 2 tons to cotton, and (*c*) 1 ton to cotton, 1 ton to jowar, in a two-year rotation shows that (*a*), the local practice is better than (*b*), but that it is best to divide the dressing between the two crops.

A comparison of eight crops, each alternating with cotton, shows cotton-jowar with or without pulses, to be the best two-year rotation for Dhárwár, when cotton is one of the crops.

Reclamation of salt land by the washing method adopted on the Gokak Canal Farm probably will not pay—land worth nothing five years ago is now estimated to have a rental value of Rs. 7 per acre. Capital expenditure has amounted to Rs. 260 per acre and the land will have to improve very much more before any profit will be possible.

To conclude, the staff have on the whole worked well and amongst the junior members Messrs. G. L. Kottur, S. S. Salimath and V. R. Dharwarkar, the first as Cotton Supervisor, and the last two as District fieldmen, deserve special mention.

Mr. A. N. Brahme, Head Clerk to the Deputy Director of Agriculture, Southern Division, Dhárwár, knows and does his work thoroughly.

T. GILBERT,

Deputy Director of Agriculture,
Southern Division, Dhárwár.

APPENDIX E.

WORK DONE UNDER THE DEPUTY DIRECTOR OF AGRICULTURE, SIND, 1915-16.

ORGANISATION.

1. The Agricultural Department in Sind is represented by one Deputy Director of Agriculture with a staff of Indian Assistants. Of these the Divisional Inspector of Agriculture, a gazetted officer on a salary of Rs. 200 rising to 350, is the most important. The other subordinates are classed in two groups according as they are or are not graduates of the Poona Agricultural College. Within each of these groups there are several grades. On the 30th June 1916 these were—

Grade.		Graduates.	Grades.		Non-Graduates.
Number.	Scale of salary.		Number.	Scale of salary.	
IV	75–5–100	10	I	50–2–60	1
			II	35–2–45	2
			III	20–2–30	8
				Special posts.	
				75–5–100	1
				50	1

2. There are four experimental farms at the marginally noted centres and one seed farm of 200 acres at Mirpurkhas. These farms are managed by Superintendents selected from the most experienced members of the Department in Sind. The district work is conducted through the Divisional Inspector of Agriculture who has 5 District Agricultural Overseers to assist him. Agricultural education is provided for by a school at Mirpurkhas under the management of a Head Master, a graduate of Poona.

Mirpurkhas.
Sukkur.
Lárkána.
Landhi.

3. The budget of the department in Sind for the year 1916-17 amounts to Rs. 87,008 and is distributed as follows :—

	Rs.
Salaries of Officers and Staff	.. 35,528
Contingencies	.. 51,480

SEASON.

4. *Inundation.*—This is the most important feature of the Agricultural season in Sind as the rainfall amounts to only 5 or 6 inches in a normal year. Although the river was slow to rise and never rose very high, being frequently 2 feet below " Fair Irrigation Level " at Bukskur, the inundation canals worked surprisingly well on the whole except perhaps in Nawabshah District. The inundation however closed about three weeks earlier than usual and late sown crops suffered. The most important perennial canal, *viz.*, the Jamrao worked well until the close of the Kharif season when a rotation had to be introduced earlier than usual which ultimately became one in four instead of one in two weeks towards the end of the rabi season. This seriously affected the increased area sown with wheat and much of it was more or less ruined. There was practically no rainfall ; less than an inch being recorded in many parts of Sind which reacted adversely on " bosi " or unirrigated rabi crops and seriously reduced the fodder supply. This was severely felt in the Desert and in the hilly country, west of the Indus, both of which solely depend upon rainfall. There was in consequence heavy mortality among the cattle and much emigration among the people. Frost in the first week of February did a good deal of damage to flowering rabi crops and to fruit trees. Mangoes in particular suffered considerably. The hot weather months were abnormal being much cooler than usual and the forty days of great heat from mid-April to the end of May were not severely felt. Of crop pests Chilo simplex or stem borer did immense damage all over Sind but particularly in Upper Sind where jowar forms the staple crop of cultivation. Potato disease (*Fusarium sp.*) was severe in the Malir-Landhi tract.

American Cotton in Sind.

5. After some years of preliminary experiments it was decided in 1912 to make a serious effort to introduce American cotton into Sind. It had long been realised that the absence of any market for staple cotton in Sind was one of the most formidable difficulties to be got over and after conferring with the cotton trade in Bombay and at Home an arrangement was arrived at by Government by which certain leading members of the cotton trade in Bombay should form a Syndicate for purchasing this cotton at a rate commensurable with its real value. This Syndicate erected factories at Mirpurkhas and Shikarpur and agreed to handle the crop for three years. This period commenced with the season 1912-13 when owing to the difficulty of getting seed from America in time little could be done. In 1913-14, 40 tons of seed were obtained from America, of which 10 tons were distributed in Upper Sind and 30 tons in the Mirpurkhas tract served by the Jamrao Canal. Nothing materialized in Upper Sind owing to the unfamiliarity of the people with cotton cultivation and the lateness of the inundation. Over 500 bales were produced on the Jamrao and this cotton was graded in Liverpool at 1*d.* to 1½*d.* per lb. below "Middling American" and was paid for accordingly by the Syndicate. The season 1914-15 coincided with the Great European War. In Upper Sind the crop failed for lack of attention and care on the part of the people. In the Mirpurkhas tract some 550 bales were obtained but the Syndicate failed to secure more than half of this quantity owing to mismanagement. The operations of the Syndicate were unsatisfactory throughout and the Zemindars lost all confidence in that agency. In the year under report (1915-16)* the Syndicate did not operate and the local agency of Messrs. Ralli Brothers bought the greater part of the crop while the Japan Cotton Trading Company purchased some 1,500 maunds. In the meantime Government opened a seed farm of 200 acres near Mirpurkhas (1913-14) chiefly for the production of good seed of American cotton. American cotton has how been grown in the Mirpurkhas tract sufficiently long to enable an opinion being formed on the prospects generally of this cotton in lower Sind.

6. The chief considerations are—

(1) relative yielding capacity per unit of area
(2) relative ginning percentage and
(3) relative price compared with local Sindhi cotton.

Outturn.—As regards this factor, the following figures are available from the Mirpurkhas Farm records for Triumph American cotton which is the variety recommended by the Department of Agriculture in the United States of America for cultivation under irrigation and which trials in this country have shown to be the most suitable for the conditions obtaining :—

Year. †	Yield of seed cotton per acre in lbs.	
	Triumph cotton.	Sindhi cotton.
	Plot D-2 ‡	Plot D-1.
1911-12 ..	618	773
1913-14 ..	616	859
1915-16 ..	983	1,173
Average for three seasons.	739	935

The conditions of cultivation were good—the land being clean and the seed sown on ridges in both cases. The advantage of yield works out at 25 per cent. in favour of Sindhi cotton and the margin would be greater were the conditions of cultivation worse.

Ginning percentage.—Messrs. Ralli Brothers who have had considerable experience with American cotton grown in Sind as well as with the local Sindhi variety inform me that a maund of 41 seers of seed cotton yields—

13·75 seers of lint in local Sindhi cotton and
12·75 seers of lint in Triumph cotton.

In the year under report the Mirpurkhas seed farm crop of 718 maunds gave an average yield of 13 seers of lint per 41 seers of seed-cotton. This corresponds to a ginning percentage of 31·72. The figure would have been a little higher had our sample of lint been less clean for we removed 10 maunds 27 seers of 'katchra' from the seed cotton in the processes of opening and ginning.

* The crop amounted to 560 bales on the Jamrao.
† The years 1912-13 and 1914-15 are omitted as the plots were found to be not comparable.
‡ This plot is slightly inferior to D-1 woing to the presence of a little 'kalar'.

The difference in yield of 25 per cent. must be regarded as provisional but assuming it to be correct and taking both these data into consideration we see that the cultivator would be compensated if he secured 25 per cent. more for his seed-cotton of Triumph American than for that of his Sindhi variety. Now a simple calculation* shows that the Trade could afford to give 25 per cent. more for American seed-cotton provided it could realize 41½ per cent. more for the "clean" cotton and the same rate for the seed of both cottons. The sale of seed should not present any difficulty if American cotton is taken up on a fairly large scale and as regards the "clean" cotton it will be seen from the following figures that Sind-American lint is worth some 42½ per cent. "on" Sindhi lint, when saw-ginned and marketted in clean condition and free from admixture :—

Let Fine Sindhi cotton † be worth ..=5·75*d.* per lb.
Then Fine Broach cotton would be worth ..=7·55*d.* per lb.
But spot Middling American is normally worth 30 to 40 cents "on" Spot Fine Broach in Liverpool market ‡ ..=7·90*d.* per lb.
Now a recent valuation § received from the British Cotton Growers' Association placed Sind American at 8·20*d.* when "Middling American" was at 7·90*d.* per lb. ..=8·20*d.* per lb.
Now 8·20 amounts to an advance of some 42½ per cent. on 5·75

On the other hand it is important to remember that Zemindari American cotton forwarded to Liverpool in 1913-14 was graded in Liverpool at 1*d.* to 1½*d.* below Middling American because of its dirty condition.

Price.—The following statement summarizes the prices obtained in past years for local and Triumph American cottons :—

Year.	Rate in rupees per maund of 84½ lbs. of seed-cotton.					
	Local Sindhi cotton.			Triumph American cotton.		
	Rate.		Remarks.	Rate.		Remarks.
	Rs.	a.	p.	Rs.	a.	p.
1906-07 ..	4	2	3			
1907-08 ..	6	10	0	These rates were obtained by the Mirpurkhas Farm.		
1908-09 ..	7	2	0			
1909-10 ..	9	8	0			
1910-11 ..	11	8	0			Not cultivated on a large scale.
1911-12 ..	9	0	0			
1912-13 ..	9	4	0			
1913-14 ..	7	8	0	These are the available rates at which Messrs. Ralli Brothers made purchases.	8 12	0 These were the approximate rates paid by the Bombay Syndicate.
1914-15 ..	4	5	0		6 8	0
1915-16 ..	8	4	0		9 1	0 This was Messrs. Ralli's average rate.

* *Foot-note.*—Suppose the rate for "clean" cotton to be Rs. 21 per 80 lbs. and the rate of cotton seed to be Rs. 3 per 80 lbs.
Then 400 lbs. of seed cotton having a ginning percentage of 33·54 (*i.e.* 13·75 seers in 41 seers) would yield

		Rs.
134·26 lbs. of "clean" cotton at Rs. 21	=	35·242
265·74 lbs. of seed at Rs. 3	=	9·953
		45·195

An equal quantity of seed cotton possessing a ginning percentage of 31·1 (*i.e.* 12·75 seers in 41 seers) if sold for 25 per cent. more than Sindhi seed cotton would command Rs. 56·494 made up as follows :—

		Rs.
124·4 lbs. of "clean" cotton at Rs. x	=	$\left(\frac{124\cdot4}{80}\right)x$
275·6 lbs. of seed at Rs. 3	=	10·335
Therefore		
$\text{Rs.}\left(\frac{124\cdot4}{80}\right)x + \text{Rs. } 10\cdot335$	=	56·494
$\text{Rs.}\left(\frac{124\cdot4}{80}\right)x$	=	46·159
x	=	$\frac{46\cdot159\times80}{124\cdot4}$
	=	29·68

or x exceeds Rs. 21 by 41·4 per cent.

† *Vide* page 5 of the 15th April 1916 issue of the "Bombay Exchange Gazette".
‡ The Editor of the "Bombay Exchange Gazette" in a letter, dated 1st April 1916, to the Deputy Director of Agriculture in Sind.
§ *Vide infra.*

Except in 1914-15 when the cotton market became disorganised owing to the Great War the premium for American seed-cotton over local has fallen far below 25 per cent. and the cause seems to lie largely in the absence of any organised trade in American Raw Cotton in India.

Intrinsic Value of Sind American Cotton.—Over 40 bales of this cotton were produced on the Government Seed Farm at Mirpurkhas in the season under report (1915-16). Of these 30 bales were sold to the Elgin Mills, Cawnpore, and 10 bales to the Empress Mills, Nagpur, through the representative of Messrs. Tata Sons and Co., at Lyallpur, on the 18th-22nd January 1916 for just under 6*d.* per lb., Mirpurkhas delivery, when the spot quotations at Liverpool for Middling American stood as shown in the margin. About the close of 1915 freight from Karachi to Liverpool amounted to 100 shillings per ton inclusive of insurance which corresponds to a charge of three-fourths of a penny per lb. to which has to be added one-fourth penny for Liverpool charges including storage, etc. After the new year, freights made a further enormous advance and stood at 180 shillings per ton for cotton in Karachi during January which must have influenced spot quotations in Liverpool bringing up a Mirpurkhas rate of 6*d.* to a rate of seven two-thirds in Liverpool.

Date.	Liverpool Spot quotations in pence per pound.	
18th January ..	8·27	
19th „ ..	8·28	
20th „ ..	8·12	8·20 average.
21st „ ..	8·09	
22nd „ ..	8·21	

The Empress Mills of Nagpur who purchased 10 bales reported that they were much struck with the quality of the cotton, its fairly long staple, and its remarkable whiteness and purity. Owing however to a defect in the Saw-gin which had been used some of the fibre had got cut and the spinning results were not so good as anticipated. The defect in the Saw-gin has been detected and will be remedied.

One bale of this cotton was forwarded to the British Cotton Growers' Association in Manchester who kindly had it valued by an expert whose report was as follows :—

"Very good colour, "Good Middling" in grade, staple $1\frac{1}{16}$" to $1\frac{1}{8}$" strong. If in commercial quantity value 8·20*d.* with Middling American at 7·90*d.*" (mid-April 1916). This shows that the cotton was valued at 30 points "on" the price of spot Middling American.

The Elgin Mills, Cawnpore, after consuming 30 bales reported "We were very well pleased with the quality of the Sind-American cotton which we purchased from you and which on the basis of "Middling American" we consider would be worth about $\frac{1}{4}$*d.* per lb. more than the price of "Middling" American.

These two valuations from sources very far apart closely coincide and prove that Sind is capable of growing American cotton of a quality which grades with "Good Middling" from acclimatized seed in the third season after the original importation from America which disposes of the criticism that American cotton deteriorates in Sind.

We may therefore conclude that American cotton of excellent quality can be produced in lower Sind, at any rate, but that owing to various causes such as red-leaf-blight, boll-worm, white ants and demand for careful cultivation it does not under existing conditions yield so well as the local Sindhi variety and hence the future of this cotton in Sind depends upon whether the trade are prepared to pay a substantial advance on the rates obtaining for Sindhi cotton and upon the condition in which the crop is put on the market by the Zemindars.

Other Cottons.

1. Egyptian cotton has now been definitely abandoned as it requires a very long growing season which is difficult to fit in owing to frost after the new year and liability to canals being closed in the hot weather months. It moreover is not a heavy yielder under Sind conditions and requires careful cultivation while it is liable to great damage from boll-worm.

Combodia and Buri cottons have hitherto been tried on only a small scale but appear to suit the conditions in Sind as well as, if not better, than any American varieties. Arrangements are being made for more extensive trials. Experiments are also in progress with Bani cotton which has perhaps the strongest fibre in the cotton world but which when grown under rainfall conditions yields poorly. The famous Karangani cotton of Madras which is reported to spin 40*s.* is also under trial as well as several others.

7. *Local Sind Cotton.*—This cotton consists of a mixture of neglectum types and is similar to the mixture found all over Central India including Khandesh, Berar and parts of the United Provinces and the Punjab. Steps have now been taken to isolate the different types and there is probably as much scope for developing the best local type in Sind as there has been in Khandesh and Berar.

Wheat.

8. A common feature of Sind wheat fields is a hopeless mixture of red, white, bearded and beardless varieties with a certain percentage of barley. Even in the most advanced tracts

no serious attempt has been made to grow pure varieties. In the year under report a comparative experiment was conducted at Mirpurkhas (the Seed Farm) when several well-known wheats were compared with the local red and white varieties with the following results :—

Name of Variety.	Yield in lbs. per acre.		Remarks.
	Grain.	Straw.	
Pissi ..	2,256	3,402	Damaged by 'kalar' about a maund per acre.
Mundi ..	1,707	2,560	
Sindhi, Red ..	1,638	2,666	
Tamra ..	1,546	2,214	Do. do.
Sindhi, White ..	1,494	2,186	
Pusa 12 ..	1,478	2,080	
Kala Kasal ..	1,296	2,262	Considerably damaged by frost when in flower (February 5).
Bansi ..	1,234	1,920	Damaged by 'kalar' about ½ a maund per acre. Considerably damaged by frost when in flower (February 5).

Previous to sowing, the land was watered once in the month of June (24th) to enable the surface to be roughly broken. Again in October-November two waterings were given to prepare the seed-bed and provide moisture for early growth. During the growing period three irrigations were given, on 10th January, 1st February and 29th Februray, respectively. A watering probably amounts to 4 inches when the land is dry and 2-3 inches when containing some moisture. The land was not harrowed during the growing period, The whole area was sown with a two coultered Gujarát seed drill which spaced the rows rather too wide. In addition two plots of Pusa 12 were broadcasted, one by the Punjab method and one by the Sindhi method and gave the following outturns :—

Method of sowing.	Yield in lbs. per acre.		Remarks.
	Grain.	Straw.	
Punjab method ..	1,867	2,582	Damaged by 'kalar' about 20 lbs. per acre.
Sindhi method ..	1,712	2,518	

It will be noted that Pissi has done best with an outturn of over 28 maunds of grain. The seed was received from Dohad. This variety has a soft white grain and is the well-known wheat of Central India.

Mundi is the irrigated variety of Khandesh ; it possesses short awns and has a soft white grain.

The Tamra seed was received from Nadiad having been imported from the United Provinces some 7 or 8 years ago. It did well on a sandy soil at Nadiad. The grain is hard in texture.

Pusa 12 did not yield as well as it promised and it will be noted that it has given better results on other plots. It produced very attractive earheads having dull red glumes. The seed was received from the Punjab and it yielded grain having a medium texture and colour.

Kala-Kasal is the best irrigated Deccan wheat but is rather liable to rust. Its grain is of the Macaroni type as is also that of Bansi which is a very superior wheat cultivated in Khandesh as an unirrigated crop. Sindhi red wheat has awns but Sindhi white is practically beardless.

Jowar.

9. Gujarat varieties have been found too late for Sind though superior in quality to local varieties.

The most important phenomenon connected with jowar in the year under report has been the virulent attack of stem borer (Chilo simplex). This pest has been particularly bad all over Upper Sind where jowar is the staple crop. Remedial measures such as removing jowar stubbles after harvest are not practicable at the present stage of development in Sind while Entomologists have not as yet developed a mode of attack through the medium of its parasities. Probably the soundest course to adopt is to substitute bajri whereever possible and it is to be hoped that this pest will return to normal numbers in the course of a year or two as was observed in the case of the epidemic which broke out in 1911 in the Surat District.

Paddy.

10. Experiments conducted at Larkana in transplanting paddy did not result favourably to planting one seedling. The local system is to plant a bunch which may contain anything up to 20 plants. Probably two seedlings per bunch will prove sufficient, as at Ahmedabad, as this provides liberally for casualties. At Larkana a test was made in the year under report to ascertain the percentage of husked rice yielded by the famous local paddy Jajai-Sugdasi—18·5 lbs. of paddy were carefully decorticated and yielded 13·5 lbs. of rice or approximately 73 per cent., inclusive of broken grains.

At Sukkur where paddy is being grown in connection with the relcamation of 'Kalar soils' it was found that the early (60 days) variety called Sathryoon yielded 1,840 lbs. of grain per acre against 1,360 lbs. yielded by Kangani and 960 lbs. by Sugdasi. Sathryoon not only gave the best outturn but was ready for harvest nearly a month earlier than Sugdasi. At Sukkur the local seed-rate is one kasa (27 lbs.) sown in $\frac{1}{40}$th of an acre plot for transplanting $\frac{1}{2}$ acre. In the year under report 9 lbs. of seed were found sufficient to transplant $\frac{1}{2}$ acre and there seems good reason for supposing that the present seed-rate is about three times as much as necessary. At Sukkur the variety—Red Lari—was sown on 5 acres of a fresh piece of bad 'Kalar' land recently taken up; it yielded at the rate of 560 lbs. per acre.

Potatoes.

11. This is a very important crop in the Malir-Landhi tract of Karachi District where some 2,000 acres are cultivated annually. Two varieties are cultivated, *viz.*, round white and long white. The former are sown in October and harvested at the end of January. The latter are sown in January and harvested in March. There is no practice of growing potatoes in the kharif season. Both varieties are imported from Italy. Round seed is never preserved from one season to the next but long seed is occasionally carried over. In the year under report owing to the Great War fresh Italian seed was very difficult to obtain but in the end the Governments of India and Italy agreed to the export of wheat and potato seed in equal quantities. The seed arrived fully a month late and the price of it was prohibitive, *viz.*, Rs. 8-13-0 per maund delivered at Landhi Station. In consequence of late sowing the crop grew poorly and became badly attacked with "wilt" *(Fusarium Solani)*. This was general over the potato area in the Landhi-Malir tract. When the crop was harvested prices fell very low owing to the Karachi market being glutted with potatoes sent down in train loads from Farakhabad U. P. and sold for Rs. 1-8-0 per maund inclusive of bags. The Government farm crop at Landhi was sold for Rs. 2 per maund and the outturn was very poor amounting to only 3,920 lbs. per acre on the best plot. There can be no doubt the potato crop in the Malir-Landhi tract received a severe blow in the year under report.

12. In last year's report the result of storing seed from 10th January to 10th June was reported and the excellent result of a loss of only 12 per cent. was recorded. The same success was not met with in the year under report when seed was preserved from 1st March 1915 to 14th October 1915—the normal period of storage required for the Malir-Landhi tract as there is no practice of growing potatoes in the kharif season. During these 7½ months the months of highest temperatures were June 114°, July 105° and September 110° and this excessive heat caused much of the seed to rot inspite of frequent fumigation with sulphur and spraying with crude oil emulsion. The following figures summarize the results obtained :—

Date.	Total weight of potatoes in lbs. stored.	Weight of potatoes in lbs. in each box.
1st March 1915 ..	3,360	$7\frac{7}{15}$
14th October 1915 ..	1,760	$3\frac{11}{15}$

The loss amounted to some 48 per cent. and the surviving seed proved to be of very poor quality as will be gauged from the result of the experiment tabulated below :—

Number of Plot.	Source of seed.	Yield in lbs. per acre.	Remarks.
C-3 Part ..	Stored ..	384	The new seed had the disadvantage of being sown on 22nd November or 5 weeks later than stored seed and it had the additional disadvantage of being sown in furrows.
C-3 Part ..	New ..	2,560	

13. Another experiment was conducted at Landhi to see whether a crop could be raised by planting newly harvested seed in early February but without success as the crop failed to develop.

14. At Mirpurkhas in the rabi season a small quantity of seed obtained from the Simla monsoon crop failed to germinate which supports the view that hill seed is unreliable for sowing in the plains.

Berseem.

15. The question of producing seed in Sind of this crop instead of importing it every year from Egypt has been engaging the attention of the Department for the last year or two. In 1911-12 an experiment conducted on one plot on the Mirpurkhas Experimental Farm resulted in an yield of $2\frac{3}{4}$ maunds of seed per acre. Little could be done in the years 1912-13 and 1913-14 owing to unfavourable conditions. In 1914-15 the average outturn of four plots was just under 2 maunds per acre. In 1914-15 an area of 85 acres of berseem on the newly opened Seed Farm at Mirpurkhas gave an average yield of only 23 lbs. per acre but the crop was full of chickory. In the light of this experience some doubt arose as to whether Sind could profitably raise berseem seed. In the year under report two experiments were conducted on the Mirpurkhas Seed Farm. The first of these was a manurial one and the second a seasonal one and they were designed to see whether the outurn of seed is dependent on either of these factors.

16. It was thought that perhaps basic slag would have a beneficial effect upon berseem in view of its well known action on clover in Europe. Accordingly six plots each measuring approximately one-fifth of an acre were measured off. Three of these were kept unmanured as controls while the other three were dressed with slag at varying rates. The experiment was done in duplicate, the only difference introduced being the date when the last cutting of green berseem was taken. The results obtained are summarized below :—

Date when final cutting of green berseem was taken.	Yields per acre of berseem seed in lbs.			
	Average of three unmanured plots.	Treatment in lbs. per acre of plots receiving basic slag.		
		74	112	150
1-2-16 ..	190	240	229	229
15-3-16 ..	149	317	277	277
Average ..	169·5	278·5	253	288

It will be noted that there has been a decided increase of yield on all the plots treated with basic slag amounting on the average to over 50 per cent. but the yields have not been proportionate to the quantities of slag applied and hence must be accepted with caution. It will be further noted that the yield on the unmanured plots is in the neighbourhood of 2 maunds per acre while on the slagged plots it reaches $3\frac{1}{2}$ maunds. The cost of one cwt. of this manure inclusive of application was Rs. 6-13-10.

In this experiment it will be noted that the date of the previous cutting of green fodder preparatory to leaving the crop to produce seed has not had much influence on the result.

17. A separate experiment was also conducted to see whether the yield of seed would be influenced by the date of taking the final cutting of green fodder. Two adjoining pieces of land each measuring three acres were set aside for this purpose on one of which the final cutting

was taken on the 1st March and on the other the 1st April. The results obtained summarized in the following statement were largely vitiated owing to the scarcity of water at the close of the season but judging by experience the final cutting of green fodder should be taken before the 1st March :—

Series No.	Plot No.	Area in Acres.	Date of final cutting of green berseem.	Yield of seed in lbs. per acre.
9 ..	3 & 4	3	1-3-16	141
9 ..	5 & 6	3	1-4-16	103

18. On the Seed Farm at Mirpurkhas in the year under report from a total area of 88 acres 17 gunthas only 72 maunds of berseem seed were obtained. If this had happened in a year when the water supply was adequate there would have been reason for concluding that berseem seed could only be produced in Sind at a loss in those places where green fodder commands a ready market, as for example at Mirpurkhas, because when seed is taken it is necessary to sacrifise one or two cuttings of green berseem worth about Rs. 20 per cutting per acre or, say, Rs. 30 in all. Now the cost of harvesting, carting, threshing and cleaning the seed amounted to Rs. 10* per maund (less Rs. 3 the value of Bhusa†) in the year under report.

	Rs.	a.	p.
Value of green fodder sacrificed ..	30	0	0
Harvesting, threshing, etc., 3 mds. of seed ..	21	0	0
Total expenditure ..	51	0	0
Value of 3 maunds of seed at Rs. 16 per md.	48	0	0

It will therefore be evident from the marginally noted calculation that apparently a crop of less than 3 maunds of seed per acre cannot be profitably produced in Sind where there is a good market for green fodder. A smaller outturn of seed per acre would mean that a higher rate would have to be charged for the seed which would exceed the rate at which imported seed‡ could be sold. This conclusion is provisional and subject to further experience in threshing the seed.

The great profit which can be made out of the cultivation of berseem fodder was well exemplified in the year under report when there was a shortage of fodder in Sind. The best plot§ on Mirpurkhas Seed Farm gave one grazing and two cuttings of green fodder up to the 26th March previous to yielding a crop of seed. The estimated yield per acre of these three crops was 360 maunds of green stuff which realized Rs. 77-10-6 as it stood in the field and several plots realized Rs. 40 per acre before being seeded. These returns are obtained for the standing crop with rates estimated at 2 annas per maund of green fodder when grazed *in situ* and 4 annas per maund when cut and removed.

Other Fodder Crops.

19. For some years the value of finding a prolific leguminous fodder crop which could be grown in the kharif season in Sind has been recognized. Owing to the absence of the habit of "Dal" eating by the people of Sind very small areas are put under pulse crops and hence the land suffers proportionately. On the other hand, the supply of fodder even in the perennial canal tracts is frequently, if not generally, inadequate. A great many pulse crops have been under investigation on the Mirpurkhas Farm and of those tried in the year under report large seeded chaunra (Vigna Catiang) and guvár (Cyamopsis psoralioides) have given the best results. Chaunra gave two cuttings on the 30th July and 16th September, aggregating 23,200 lbs. of green stuff per acre, of which the cattle rejected less than 2 per cent. Guvár gave three cuttings on the 30th June, 28th July and 16th September, aggregating 22,400 lbs. of green stuff per acre : the coarse fibre amounting to 2½ per cent. Both crops were sown at the same time in the second week of May. Guvár also is much grown in the Malir-Landhi tract and always gives the best result on the Landhi Farm. It is hardy, grows fast and is apparently not very susceptible to "wilt" (Rhizoctonia sp.). It is interesting to note that velvet beans and soy-beans gave poor results for fodder on the Mirpurkhas Farm in the year under report, while Wál (Dolichos Lablab) only yielded 11,600 lbs. of green stuff per acre.

Soy-beans.

20. Of possible new crops for Sind few offer greater promise of success than soy-beans. The rise of this crop into commercial importance affords one of the most remarkable instances of a comparartively unknown plant, rapidly securing a recognized place in the world's trade within a very few years of its first exploitation in Manchuria. Before the Russo-Japanese

* The average for 72 maunds on the Mirpurkhas Seed Farm in 1915-16.
† Sold at 8 annas per maund.
‡ Imported seed costs Rs. 15 to Rs. 16 per maund.
§ Plot 1 of Series 8.

war this bean was commercially unknown in Europe. It is said that the first large cargo of soy-beans amounting to some 5,200 tons reached Hull on the 2nd March 1909 and ever since the demand for this product has rapidly increased. Upto 1907 the total export of soy-beans from Manchuria did not exceed 120,000 tons annually. In 1908 the shipments amounted to 330,000 tons and in 1909 they ranged between 700,000 and 800,000 tons. England offers the best market for soy-beans but the Continent has also imported largely. In the neighbourhood of Hull large elevators have been erected for handling the trade in this bean and British oil crushers have set up costly machinery for extracting the oil. A decade ago prices for this bean ruled low and there seemed little likelihood of this crop proving profitable in other parts of the world than Manchuria. In 1908 the price in England was only £4-15-0 per ton. Towards the end of 1910 the rate had risen to £8-5-0. At the same time the price of oil went up to £30 per ton and the meal left after extracting the oil commanded a price of about £6-10-0 per ton. In 1912 the Hull Oil Manufacturing Company, Ltd., quoted coarse meal at £7-5-0 and fine meal at £7-6-0 per ton.

The chief use of the oil is for soap making and this is the purpose for which soy-beans are now being largely imported into England. In China the oil is used as an illuminant as a substitute for lard in cooking though inferior to rape and seasmum oil for this purpose—as a lubricant for cart wheels and for water-proofing cloth.*

21. A sample of soy-beans grown on Larkana Farm in 1915 (black seeded variety) forwarded to the Imperial Institute was valued by a firm which deals in soy-beans at £14 per ton ex-ship Hull (March 1916) on the terms of the Incorporated Oil-seed Association and the firm expressed a desire to be put in touch with shippers in India. High freights no doubt accounted in part for this excellent valuation. In January-February-March freight from Karachi to English ports on seeds similar to soy-beans ranged from 115 shillings to 160 shillings per ton against the normal freight of 25 shillings per ton.

22. Mr. Wodehouse† has made some interesting observations in connection with the price which soy-beans can command. In the first instance he has pointed out that £6-10-0 per ton is a ridiculously low price for the meal, which is a highly concentrated foodstuff. This low rate was probably due to the fact that until quite recently it was found impossible to remove the objectionable odour due to the solvents used in extracting the oil. Of late, however, the meal has been put on the market free from any trace of the smell of these solvents. It is further noted that the price of this meal has been fixed on the basis of its value as a cattle food, but it seems probable that it will ultimately be utilized for biscuit and cake manufacture, in which case the basis of valuation would be raised and the rate of the raw material would rise in sympathy. If used in biscuit manufacture a price of £8 to £10 per ton for the meal should be easily obtained. Now soy-beans contain about 16 per cent. of oil and yield about 13 per cent. so that 100 tons of beans give 13 tons of oil and 87 tons of cake. With this data Mr. Wodehouse makes the following calculations :—

13 tons of oil at £30 per ton .. £390.
87 tons of meal at £8 ,, .. £696.
= £1,086 as the value of the manufactured products.

This corresponds to roughly £11 per ton of seed and after making an allowance of £2 per ton for manufacture and profit, this would enable a rate of £9 per ton to be paid in England for the beans. After deducting transport charges this would permit of a rate of £7 per ton or Rs. 4 per maund being paid in Calcutta, or some Rs. 3-8 0 per maund in the district. At this rate Mr. Wodehouse thinks it would pay the ryot in Bihar-Orissa to cultivate soy-beans.

23. Now we have seen above that in March 1916 the Hull rate for soy-beans was £14 per ton and the freight from Karachi roughly £7 per ton, which would enable soy-beans to command a rate of £7 per ton or Rs. 4 per maund in Karachi and therefore Rs. 3-8-0 per maund in the districts of Sind. Experiments have not yet been conducted on a sufficiently large scale to determine the yield per acre of soy-beans and moreover there are several varieties varying markedly in their maturity periods. A white seeded variety tried on a small scale on Mirpurkhas Farm in the year under report yielded with five waterings at the rate of 10 maunds per acre, which corresponds to Mr. Wodehouse's statement that yields of 8 to 12 maunds per acre may be expected.

Experiments are now in progress with 4 or 5 varieties, one of which appears to be markedly early maturing. It is therefore clear that in soy-beans we have a potentially valuable export leguminous kharif crop for Sind which some day may compete with cotton.

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* Vide page 140 of Pusa Memoirs, Botanical Series, Vol. V, No. 3.
† Pusa Memoirs, Vol. V, No. 3, Botanical Series.

Rotations.

24. On the Jamrao the Irrigation facilities admit of one-third of the land being cultivated per annum. The necessity for practising a good rotation is therefore not acute but it is probable that the irrigation facilities will be greatly improved in the future; and hence it is essential to devise a good rotation because there is no practice of manuring the land, the supply of cattle, dung, etc., being inadequate for the purpose.

With these considerations in view my predecessor laid down the following two rotations in 1908-09 which have been continued ever since including the year under report :—

	Two-year Rotation.		Three-year Rotation.		
	1st year.	2nd year.	1st year.	2nd year.	3rd year.
Beginning of year (Adhowa).	Berseem ploughed in.	Berseem seeded.	Berseem ploughed in.	Berseem seeded.	Wheat.
Kharif ..	Cotton ..	Bajri or Jowar.	Cotton ..	Fodder Crops.	Bajri or Jowar.
Rabi ..	Berseem ..	Berseem..	Berseem ..	Wheat ..	Berseem.

A third rotation consisting of continuous wheat was also commenced in the same year.

Rotation I.—It is not possible to review this rotation in detail because different varieties of cottons and jowars have been grown and hence comparisons of outturn from season to season would be misleading, but the following statement indicates in a general way how the land has yielded.

Year.	Yield per acre in lbs. of jowar Kirbi. Series. C.	D.	Remarks.
1908-09 ..	....	5,046	
1909-10 ..	5,489	....	
1910-11 ..	....	4,801	
1911-12 ..	6,296	....	The area of the Series :—
1912-13 ..	....	4,091	C. is 12 acres 19 gunthas.
1913-14 ..	4,305	....	D. is 12 acres 4 gunthas.
1914-15 ..	....	4,514	
1915-16 ..	3,313	....	
Average ..	4,851	4,613	

Again, the following statement summarizes the results obtained with cotton some seven to eight ears after the rotation was introduced :—

Year.	Yield per acre in lbs. of seed-cotton. Series. C.	D.
1914-15 ..	696	..
1915-16 ..	..	611

The outturns of Jowar grain are omitted because some of the varieties being exotics did badly. The outturns of Berseem are also omitted as a good deal of this crop was grazed instead of cut. The figures given above indicate that the land is in fair "condition" and the only criticism which can be made against this rotation is that wheat—an export crop largely grown on the Jamrao and of not less importance than cotton—finds no place in it.

Rotation II.—As regards the three-year rotation the figures of yield do not suggest a very high level of fertility as will be gathered from the following statement which summarizes the results obtained with cotton and wheat. The outturns of wheat in particular are very low and suggest something defective in the method of cultivation—perhaps the cropping was excessive for land solely dependent upon irrigation and consisting of a very fine grained soil. Such conditions demand good and frequent tillage and a reasonable interval between successive crops.

Year.	Yield in lbs. per acre of seed cotton and wheat grain.					
	Cotton.			Wheat.		
	Series.			Series.		
	B.	E.	F.	B.	E.	F.
1908-09 ..	....	....	298	345 (719)	....	514 (877)
1909-10 ..	....	546	....	....	....	....
1910-11 ..	168	....	....	....	348 (769)	....
1911-12 ..	....	....	548	....	....	....
1912-13 ..	....	705	....	....	....	350 (640)
1913-14 ..	489	....	....	....	521 (1,200)	....
1914-15 ..	....	....	431	530 (808)	....	....
1915-16 ..	....	453	....	....	....	....

Note.—Figures in brackets refer to straw yields.

Rotation III.—Continuous wheat growing at Mirpurkhas has proved unsuccessful as the yields have steadily fallen off in spite of artificial fertilizers on some plots and green manures on others :—

Year.	Average yield in lbs per acre of six plots.					
	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
1908-09 ..	759	1,384				
1909-10 ..	749	1,456	709	1,275		
1910-11 ..	619	1,152			565	1,104
1911-12 ..	504	674				
1912-13 ..	388	852	421	877		
1913-14 ..	372	1,103				

For irrigated wheat the yields appear very small but in most of the seasons the crop suffered either from shortage of water or rust. Nevertheless the outturns suggest that the crops have suffered from the exclusion of air owing to the packing of the surface brought about by irrigation. In future it is proposed to harrow the standing crop in order to break the hard surface—a practice which will be possible when a suitable lever harrow, such as is used and recommended by Mr. Howard, has been obtained.

Tillage.

25. There is nothing in the agriculture of Sind so striking as the low standard of tillage which prevails over the greater part of the province. The typical method of sowing a kharif crop, whether it be a cereal or cotton, is to irrigate the land, broadcast the seed and plough it under. The preparation of a seed bed for kharif crops is not commonly parctised except among Punjabi colonists. This practice combined with the practice of leaving land fallow for several years and the use of canal water all combine to fill the land with jungle growth, grass and weeds and the grass that grows has come to be regarded as a necessary subsidiary crop providing fodder for the bullocks, which would otherwise be unprovided for. On the other hand the soil of Sind is of alluvial origin and for the most part fine in texture. Such a soil when irrigated naturally forms a hard skin or crust on the surface which owing to the prevailing practice of broadcasting seed cannot be broken up except by hand labour, which is rare and consequently seldom utilized. Thus air becomes excluded and evaporation goes on apace. The only means of softening the surface is to irrigate again and this results in the great lack of economy of water

and the progressive damage to the texture of the soil. The obvious method of farming under such conditions is to adopt drill husbandry. In other words, to sow crops in lines several inches apart and to stir up the intermediate spaces with suitable implements at every opportunity, thereby conserving moisture, destroying weeds and aerating the soil, which results in conditions favourable to a healthy bacterial population giving "life" to the soil which soon becomes manifest from the appearance of the standing crops.

26. Steps have been taken to introduce several tillage implements from Gujarát on to Government Farms where the precepts enumerated above are being carried out in practice, and it is hoped by example and demonstration to persuade some of the more progressive zemindars to adopt these implements; but it will be an uphill task as drill husbandry postulates a good seed bed, which means additional labour, while the operations of drilling and inter-cultivating demand a certain standard of skill. Anything achieved in this direction will be well worth the trouble as land exhaustion in Sind probably rarely means exhaustion of plant food; on the contrary, it is more likely due to the unfavourable soil conditions set up under the present system of farming whereby the texture is spoiled by over-irrigation and the bacterial life killed off by suffocation.

Implements and Machinery.

27. The Egyptian plough has become widely established in Sind and is manufactured in Hyderabad and many villages and for this reason the number 92 mentioned as sold by the Divisional Inspector in the year under report only represents a fraction of those actually brought into use. The question whether it can be improved upon has arisen. The width of the share face is full $5\frac{1}{4}$ inches and where land has got rather dry it can only be worked with difficulty and then only with strong bullocks. For Upper Sind where bullocks are small and weak a reduced size might possibly prove more acceptable and some new ploughs having a share face $3\frac{3}{4}$ inches wide have been prepared as a tentative measure. Another possible improvement lies in raising the posterior end of the draught pole a few inches instead of joining it directly to the beam, as at present it is observed that when a hard clod finds its way into the angle formed by the pole and the beam, the plough is necessarily forced out of the land.

The new hard steel shares specially made in Scotland for the Egyptian plough have proved a great success and the first consignment of 1,000 has been exhausted, while another 500 are on order. Unfortunately owing to the war the price will greatly exceed a rupee per share hitherto charged.

28. Some trials have been made with Ransome's monsoon ploughs; these have several attractions for use in India. There is only one handle. The share is fitted with a renewable point. This plough is more substantial than the Meston but is neverthless a two-bullock plough. It is very well finished and made of high class material, and when used on irrigated land at the correct stage of dryness does excellent work, ploughing some 7 inches deep and turning over the soil. The pre-war delivered cost of this plough was about Rs. 20. There seems to be an opening for this plough on land intended to be cropped with "bosi" wheat where the usual practice is to give careful preliminary tillage and also on land cropped with irrigated wheat on the Jamrao Canal.

Wallace's Rajah plough has found favour in the Punjab for this class of work and trials are now in progress to see which is more suitable for Sind.

Ransome's Sabul plough costing Rs. 50 has also been tried and did excellent work in ploughing in berseem stubble and in preparing sugarcane land. It requires one pair of strong bullocks but the scope for this plough in Sind is naturally much less than for the monsoon. The Rajah plough is cheaper than the Sabul and in free working land does practically as good work.

29. The three-tined wheat seed drill used in the Tapti Valley tract will probably become popular among growers of bosi wheat who at present sow the seed by attaching a seed-bowl to the plough. The Gujarát wheat harrow and the various sizes of inter-cultivating hoes used in that Province should also prove suitable for Sind. They have been used with advantage on Government Farms in the year under report.

30. Among more expensive implements the disc-harrow has done excellent work on Government Farms but its price Rs. 130 places it rather beyond the reach of the average zemindar's hari.

31. *Water Lifting Appliances.*—The hand archimedian screw costing Rs. 30 continues to find favour on a limited scale. It is very convenient for lifting water to irrigate paddy seed beds when the water level in the Canal drops a foot or two. The large sizes of these screws do excellent work but possess one disability, *viz.*, the absence of adjustment for increasing the lift when the water-level drops. Such a screw may be put out of action and is obviously more suitable for conditions where the water level never drops below a definite limit. The Dutch wheel is open to the same criticism, and probably the best water lift for Sind conditions—other than power plants—would be an improved Persian wheel if such could be made efficient at reasonable cost. Mr. Musto has brought out designs and erected a few such improved wheels, but the cost of each is Rs. 800 and upwards. The "Noria," which is made on the same

principle as a Persian wheel, seems to be open to objection on the ground of its parts working loose and bolts getting lost and the whole becoming ramshackled.

Livestock.

32. Hitherto no attempt at cattle-breeding has been made in Sind. There are two distinct problems awaiting solution:

(1) the production of a good draught animal;

(2) the conservation and improvement of the existing breed of Karachi milch-cattle.

These two problems cannot be combined because the Karachi cattle are too small for draught work, particularly in the canal areas. As regards the first problem there is some doubt as to the most suitable breed for the purpose. Kankreji cattle from Surat herd are being used on some Government Farms. This is a very fine breed of cattle—their distinguishing characteristics being size, alertness and swiftness; but when they become old they lose the two latter characteristics, and in Sind they show some signs of lack of hardiness both as regards food and climate. These defects would probably largely disappear if the cattle were bred in Sind starting with a medium sized Kankreji bull and a good selection of local cows. The Bagnari breed of a small tract in Upper Sind provides very powerful draught cattle, and for North Sind at any rate where the climatic conditions are very severe it seems improbable that this breed could be improved upon.

33. As regards the second problem things have become rather acute in recent years owing to the heavy export of these Karachi cattle which has amounted in the last decade to something like 1,000 head per annum. Ceylon is the chief market. Recently a Hindu gentleman of Karachi, Mr. Chellaram, has placed Rs. 15,000 at the disposal of Government to start a herd of these cattle and the matter is now under detailed consideration.

34. In March 1914 the Superintendent, Civil Veterinary Department, kindly purchased on behalf of this Department three yearling heifers and one yearling bull of the Karachi milch breed. The bull cost Rs. 50 and was out of a red cow which gave 14 seers of milk per day. The heifers cost from Rs. 20 to Rs. 40 each and all were the offspring of red parents—the dams each yielding 12 to 14 seers of milk per day. The grand dam of one of these heifers (Karachi) was a famous cow in her day yielding 20 seers of milk when in full flow.

One of these heifers (Thul) had her first calf at the end of January 1916. The calf (a heifer) was weaned at birth and brought up "on the pail." It is now six months old and in good condition.

During the first six months after calving this cow gave a total yield of 3,048 lbs. of milk of excellent quality. Her daily average for long was 18 to 16 lbs., which during the month of July had become 14½lbs. She is again in calf, as are the other two heifers. In the event of a pedigree herd for this breed being started in Karachi District it is proposed to transfer this stock to that herd.

Education.

35. The Agricultural School has now been in existence nearly four years. The course extends over a period of one year and the fourth course will soon be completed. The third batch of students which passed out last October consisted of 10 boys as shown in the margin.

Mahomedans.	
Punjabis	6
Sindhis	2
Hindus.	
Amils	2

The Punjabis came from the Jamrao tract; the Sindhi Mahomedans came from Sukkur and Thar and Parkar Districts, while the Amils belonged to Hyderabad District. All the students succeeded in satisfying the examiners at the close of the session and secured certificates. It is satisfactory to note that all with one exception have taken up agriculture and are engaged on their own lands. One or two have been successful in obtaining grants of land from the Revenue Department, which will encourage Zemindars to send their sons to this school.

The current class consists of nine boys, the tenth having left soon after joining, constituted as follows:—Four Mahomedan Sindhis, one Mahomedán Punjabi and four Hindu Sindhis; and as regards districts they are distributed as shown in the margin. Most of these boys belong to the agricultural class, while all hold some land.

Hyderabad	4
Lárkána	2
Thar and Párkar	2
Nawabsháh	1

36. In Sind it is not usual for well-to-do zemindars or their sons to work with their own hands, but this is the only way by which practical agriculture can be learned. In previous years it has accordingly happened that the practical work has been largely nominal. In the year under report a serious attempt has been made to make practical work the chief feature of the course. A certain area of land was allotted to the boys who were required to perform all the operations involved in the raising of crops and they responded very well. They had half an acre of potatoes; they stripped to sow their berseem in standing water—they sowed two and a half acres of cotton and a large variety of graden crops involving the raising of seedlings

in seed beds. Perhaps the most convincing work done has been the way they have learnt to handle bullocks and implements. One or two boys who had not previously handled cattle can now drive as well as profesional haris. The class has become thoroughly familiar with the details which go to make up successful farming, such as recognising the right moment when the land should be ploughed and the seed sown and irrigation given, and much interest has been shown in fruit cultivation, such as laying out an orchard, prunning vines and grafting mangoes. During the course of the year the class was taken on two short tours, one on the Jamrao canal and one on the Fuleli Canal. On these occasions care was taken to point out to the boys both the technical and economic sides of the local agriculture. The salary of the master and his peon and the scholarships of the students amounted to Rs. 2,158-14-5. Two new quarters costing Rs. 960 were added in the course of the year, while contingencies accounted for Rs. 322-8-3, making a total expenditure of Rs. 3,441-2-8 for the year.

District Work.

37. The staff allotted to this work now stands at—

1 Divisional Inspector of Agriculture.
5 District Agricultural Overseers.

Mirpurkhas, 8th January 1916.
Shikarpur, 25th Do.
Nawabshah, 21st February 1916.

Three Shows were held in the course of the year as noted in the margin. These lhave been separately reported upon and cal for no remarks here.

The District Agricultural Overseers have toured regularly in their circles and have conducted a large number of village demonstrations, aggregating in all to 75. This is the most useful form of demonstration work as it brings the departmental officers into very close touch with the people and their difficulties while opinions and criticisms are freely asked and given in a manner which cannot be expected on an occasion involving ceremony. They also enable cultivators to put the Department's recommendations to the test with their own resources, *e.g.*, cattle. It has also been possible to arrange with some District officers for the local Agricultural officers to conduct demonstrations on kacheri days when a large number of Zemindars assemble.

38. Demonstrations of superior crops and methods are given on plots taken over by the Department for the purpose. In the year under report the Department had the marginally noted demonstration plots. American cotton, certain pulse crops and some varieties of jowar and wheat were the principal crops grown. Experience shows that it is difficult in practice to get these plots efficiently managed. The arrangement hitherto adopted has been what is called the "Hari system". In Sind most of the land is owned by Zemindars who give it out on a share system to tenants or haris. Accordingly these demonstration plots have been given out to haris who do all the work and take all the produce subject to the share due to the Department. The Department provides anything new in the way of seed or implements which have to be demonstrated. This arrangement has many advantages but it also has certain serious defects. The advantages may be summarized as follows :—

Name of Place.	Name of District.
Shikárpur ..	Sukkur.
Kandhakote ..	Upper S. Frontier.
Thariri Muhabat ..	Lárkána.
Dádu ..	
Nawabshah ..	Nawabshah.

(1) The work is carried out under similar conditions to those under which the average cultivator carries on his farming operations.

(2) It eliminates extravagant practices almost inevitable in Government management

(3) It excludes such criticism as "Government are very rich and can do anything whereas the average man is poor and cannot adopt like measures."

(4) When successful the public are easily convinced and moreover can privately discuss the matter with the haries who work the plot.

On the other hand, the defects inherent to this system are patent :—

(1) The Hari being an ignorant man is not an ideal demonstrator of something which is entirely new to him. An improved method in his hands is liable to become its own condemnation, *e. g.*, drilling seed.

(2) In spite of the local agricultural overseers' frequent inspections the hari is naturally inclined to do things in his own slipshod way, *e. g.*, to be slack in weeding his field or repairing his water lift.

(3) The hari is frequently hard up and unable to feed his cattle sufficiently to enable them to turn out the necessary work in lifting water and tilling the land and generally in getting the work done timely.

(4) The general appearance of the plot is liable to be unattractive, *e. g.*, the hurla may be set up in a slovenly manner, the land unadequately levelled, and the bullocks emaciated.

A demonstration plot must above all things present a good appearance and bear the impress of efficient management. Without these characteristics the object in view is vitiated and the plot should cease to exist as it can only produce a bad impression. An improvement well demonstrated will always create a good impression, and it is for those who witness it to test its value both practically and economically under their own conditions.

Perhaps it will be possible to devise some compromise between the two alternative systems of management—the Departmental or Hari systems—whereby an expert Jamadar of the Department will visit each plot at the critical periods and personally carry out the improvement designed, while the general management remains in the hands of the Hari; but the latter must be very carefully selected both as regards his personal qualifications and his resources.

T. F. MAIN,
Deputy Director of Agriculture, Sind.

APPENDIX F.

WORK DONE UNDER THE EXTRA DEPUTY DIRECTOR OF AGRICULTURE, KONKAN, 1915-16.

The work of the Agricultural Department in the Konkan division during the year 1915-16, fell, as in former years, into two principal categories, viz., Experimental work including investigating into new possibilities and Extension work. The former was mainly conducted at the two Agricultural stations—Alibág and Ratnágiri—the centres representing the north and the south Konkan respectively. A new Agricultural station at Kumta has been sanctioned, where work will be commenced from the next year. Some simple tests were carried out or results of the Agricultural stations verified on cultivators' fields under the direction and supervision of the district staff. The extension work is chiefly carried out by the district staff. We have now a separate Agricultural Overseer for each district. In some localities, the Agricultural Associations have co-operated with the Department in this task.

EXPERIMENTAL WORK.

RICE.

2. Owing to the peculiar climatic conditions of the Konkan, rice has necessarily been the principal food crop of the low-lying areas and occupies on an average 68 per cent. of the total cultivated area. It is natural therefore that most of the experimental work should be concentrated on the improvement of this crop. The work during the year was mostly a continuation on the lines adopted in previous years, and has yielded results which are summarized under each head.

I.—MANURIAL EXPERIMENTS.

3. *Rab and Rab substitutes.*—The results both at Ratnágiri and Alibág farms show that equally good or even better seedlings can be grown with substitutes like oil-cake, fish manure or ammonium sulphate. It is alleged that the seed-beds will be very weedy or the seedlings cannot be uprooted as easily as from a burnt seed-bed and consequently some of the seedlings are likely to be broken out from the root stock. But no such conditions were noticed both at Ratnágiri and Alibág farms, where the substitutes alternated with the rab-burnt plots in the previous year. The greatest consideration in favour of rab with such farmers as put in their own manual labour is that they have not to make any out-of-pocket expenditure. Wherever, however, rab materials are insufficient, it would be profitable to use all the available material on only so much area of the seed-bed as it will suffice to produce optimum results, and use substitutes on the rest.

The attempt to economise rab materials by using only one-quarter of the materials in alternate layers of soil and rab in a heap has not been successful.

Experiments on the Alibág farm have shown that rabbing of seed-beds in the beginning of April gives better results than either earlier or later.

4. *Green-manuring with san and dhaincha.*—A conspectus of results obtained on the Ratnágiri farm fully establishes the benefit of adding green matter in the form of san and dhaincha crop, though similarly good results are not noticeable at the Alibág farm, which may be due to unequal fertility of the plots under comparison. The possibilities of growing these crops, however, in the low-lying rice fields after the commencement of rains are only occasional and few, as heavy beating showers and flooding of fields, which conditions are not uncommon in Konkan, almost kill the san crop; and dhaincha which can withstand water-logging and heavy showers is a very slow grower. In the well drained sandy fields along the coast, or high-lying fields where water could be controlled, there is better scope for success with san.

Where varkas lands are not very far from rice fields, san crop grown on such lands in the beginning of rains could profitably be transferred to rice fields. San crop grown on bandhs, where they are high and wide as in the North Konkan, would suffice for a part of the rice fields.

Wherever cheap irrigation facilities exist, giving a fortnight's start to both san and dhaincha before the commencement of rains with the help of irrigation water would undoubtedly be very profitable as experiments on the Ratnágiri farm have proved. There are many places in the Southern Konkan where such facilities exist and *vaingan* (hot-weather irrigated) rice is grown. After the harvest of *vaingan* crop, san or dhaincha can be grown under the same source of water supply. This year an experiment was tried on a cultivator's field at Pochri, Táluka Sangameshwar, District Ratnágiri, where san sown after the harvest of the kharif rice crop was ploughed in at the time of puddling for sowing the *vaingan* crop. The outturn from the green manured plot yielded nearly double the local treatment plot.

As regards obtaining sufficient green matter from dhaincha it might be possible to make a permanent plantation on varkas lands adjoining the rice fields or on bandhs and keep them pruned.

5. *Green leaves of karanj.*—Another very striking result of the value of the addition of green matter to rice fields has been obtained on the Alibág farm with karanj leaves. Incorporation into the soil of green leaves of karanj at the rate of 4,000 lbs. per acre before puddling

has increased the outturn by 275 lbs. of paddy per acre which is valued at Rs. 8. There are many karanj trees in the North Konkan and more could be planted along the boundaries of farmsteads or on varkas lands.

6. *Field manures.*—Bulky as well as concentrated manures were tried both at Ratnágiri and at Alibág.

In the case of bulky manures, on the Ratnágiri farm cattle folding, crude night-soil, urine earth and rice hulls were tried and all have resulted into substantial increases. At the Alibág farm, mowra refuse and a heavy dose of crude night-soil, poudrette, urine earth and rice hulls were compared with no manure. Mowra refuse has proved to be the best as in previous years and has now passed the experimental stage; poudrette and rice hulls have shown up better than in previous years; urine earth, contrary to the results obtained at Ratnágiri, show absolutely no improvement; the heavy dose of crude night-soil only stimulated rank vegetative growth at the expense of grain.

7. The concentrated manures tried were oil-cake (karanj at Alibág and undi and groundnut at Ratnágiri), fish, ammonium sulphate, bone-meal and superphosphate. At both the farms the results are most conclusive in proving that the nitrogenous manures of oil-cake, fish and ammonium sulphate supplying 20 lbs. of nitrogen per acre could enhance the outturn of rice to the extent of leaving a substantial net profit. Nothing can be yet said, however, of the comparative merits. Increasing the quantities by 50 per cent. or 100 per cent. have not on the whole increased the net profits.

Bone-meal at the rate of 400 lbs. per acre has effected a marked increase which when applied singly is not, however, enough to pay its own way. Bone-manure acts slowly and further results will be awaited. Perhaps application of a less quantity may leave a profit. When bone-meal is, however, combined with karanj leaves the increase leaves a good profit after paying the cost of bone-meal. Mineral superphosphate which was tested at Alibág has caused a decrease when applied alone but when combined with nitrogen in the form of ammonium sulphate or with green leaves of karanj has effected a marked increase.

8. *Indirect manures.*—The effects of lime and salt have been contradictory in the duplicates at Ratnágiri. At Alibág, salt has shown a slight advantage.

II.—Cultural Experiments.

9. *Preparatory tillage.*—An experiment of ploughing the rice lands in the hot weather has been in progress for the last four years on the Alibág farm. This year's results confirm those of the previous year that exposing the land to the sun in the hot weather gives no advantage to the following rice crop. Similar has been the fate of very deep cultivation by hand after the Japan method. In some coastal tracts of Kánara it is, however, the practice of upturning the land by hand implements.

10. *Number of seedlings in a bunch and spacing in transplanting.*—Both at Alibág and at Ratnágiri, four vigorous seedlings in a hole obtained by burning 50 per cent. more rab and using only one-third the usual seed-rate and transplanted at a distance of 9″ × 9″ has given more outturn than 16 or 12 seedlings in a hole at a distance of about 12 and 9 inches both ways respectively as locally practised. The experimental data at Alibág help to suppose, however, that the advantage is more due to the extra vigour of the seedlings than to number of seedlings in a bunch. This matter will be studied in future.

The experiments further indicate that a thicker spacing of 6″ × 6″ with four strong seedlings is likely to give more yield.

11. *Transplanting* vs. *broadcast or drill sowing.*—In some tálukas of the Ratnágiri District along the coast there is the practice of sowing sprouted paddy seed (rahu) in a puddle on the high-lying (kuryat) rice fields. This method dispenses with the necessity of rab and saves a lot of expense entailed for lifting and transplanting. This method is not, however, in vogue through out the district even on higher situations and the cultivators claim that transplanting will give a better yield than rahu sowing. In order to find the truth, rahu sowing and transplanting were compared on high-lying lands on the Ratnágiri farm. The results are contradictory in the two duplicates: so an opinion must be reserved pending further trial.

For the same advantages as obtained in rahu, it was also tried at Ratnágiri whether sowing of seed in lines would not be as good as transplanting. It was, however, observed that the seedlings in the sown plot make a poor growth, the soil gets infested with weeds and packed by the heavy showers, the operations of weeding and stirring the soil cost as much as rab and transplanting, and the ultimate outturn is also much less.

III.—Improvement of Seed.

12. *Grading and mass selection.*—Grading of paddy seed by the salt water method has shown no benefit as in previous years. Selection of big and well developed ears has consistently with previous years resulted into an increased outturn worth about Rs. 6 per acre, which is more than worth the trouble of selecting the required quantity of ears.

IV.—Varietal Experiments.

13. One is surprised to see such a large number of varieties of rice in the Konkan. There are of course some soil and climatic variations, which demand different varieties, such as early and late, those suitable for saline lands, etc., but even in different parts of the same táluka a number of sets is met with, the reasons for which are not yet clearly understood. Some attempt has been made to study some principal varieties. At Alibág, an early variety, called *halve*, has stood first in point of outturn and money value; *bhadas* the locally grown variety stands next; *kolamba* a finer variety, owing to its higher price, equals *bhadas* in point of money return. At Ratnágiri, where *kolamba* was not tried, *bhadas* and *halve* came first and superior to the local *vanksal* variety in the low-lying fields, while *nava-jirga* and *mushakdanti* are superior to *halvi patni* on the high-lying areas.

Bandh crops.

14. Rice fields have to be enclosed by embankments or *bandhs* to preserve the level and the necessary quantity of water in them. These bandhs serve to some extent to supply grass for cattle when it is tender and for rab when it is ripe. But along with this some more valuable crops can be grown, either for home consumption or for market.

A variety of crops, such as *mendhal (dolichos spp.)* and *tur*, on retentive soils, and *udid* and *chavli* on less retentive soils were tried with very good results.

Rabi crops after the harvest of rice.

15. In favoured situations dry crops of *val, tur, kulthi, udid, mug*, gram, castor are successfully cultivated in various parts of Konkan. The conditions which determine the choice of particular crops in particular localities will form the subject of future investigations.

Tobacco was tried at Ratnágiri in low-lying fields but the moisture was too much throughout the hot weather which delayed the ripening. The growth was also not as vigorous as it should be. This will be tried on drier situations.

Irrigated crops.

16. Irrigation facilities, wherever they exist in Konkan, are not properly resourced except for cocoanut and betel nut palms in the coastal belt, and for vegetables and market gardening round about Bombay. In the Ratnágiri and Kárwár Districts there are many localities even inland where stream or well water could be made available. This water is often wastefully used only for *vaingan* rice or irrigated *nagli*. In the inland of the north Konkan, such facilities though few are not turned to advantage at all. With a view to find out remunerative crops suitable for Konkan experiments have been in progress both at Alibág and Ratnágiri farms.

17. *Onion.*—The results both at Alibág and Ratnágiri show that onion is the most profitable, short seasoned crop that can be extensively introduced in Konkan Agriculture. It is, moreover, an essential article of food of the rich and the poor and can be stored. It yielded at the rate of 10,000 lbs. at Ratnágiri and 20,000 lbs. at Alibág, valued at Rs. 150 and Rs. 300 respectively. At Alibág a combination of 6 tons of poudrette and 800 lbs. of fish manure has been found very paying. In Kánara this crop continued to give satisfactory results.

18. *Chillies.*—This was tried at Ratnágiri, and a yield of 1,700 lbs. of dry chillies per acre valued at Rs. 300 was obtained. Poona chillies did not do as well as in the previous year. This crop has the same advantages for its introduction as onion.

19. *Sugarcane.*—This has been under trial only on the Ratnágiri farm. The outturn of the local Deogad variety was 6,140 lbs. of gul per acre, while the Red Mauritius variety yielded at the rate of 8,145 lbs. The heaviest item of expenditure was irrigation, as the coarse open laterite soils of Ratnágiri District require irrigation every four days. Where flow irrigation is available, this crop will yield a profit of Rs. 200 to 300 per acre. A combination of 40 cart-loads of farm-yard manure with 1,200 lbs. of oil-cake and 375 lbs. of sulphate of ammonia was found to be the most profitable.

Further tests in the Kárwár District with Red Mauritius variety of sugarcane confirm its superiority over the local Das kabbu which is being gradually replaced.

As a result of some tests carried out in Kánara District *Chatanooga* No. 12 has been found superior to any of the wooden, Bellary iron or locally manufactured iron mills. This gives about 68 per cent. extraction and the output of work is two or three times that of the local wooden mill.

20. *Potatoes.*—This crop did not succeed at both the farms.

21. Vegetables like cabbages, tomatoes, knolkhol, vegetable chillies also succeeded at Ratnágiri, and can be added to the list of vegetables already being grown for home consumption or near cities and towns for marketing.

Improvement of Fodder-supply.

22. The pitiable condition of Konkan cattle is partly due to insufficiency and poor quality of fodder, but chiefly due to want of any efforts on the part of the owners to devote any care

to their feeding. The experiments that have been undertaken therefore aim at improvement of the quality and quantity of fodder (1) by introducing better varieties of grasses, (2) by ensilage and (3) by finding out suitable crops for cultivation.

23. *Introducing better varieties of grasses.*—A comparison of several wellknown grasses from various tracts has been taken up. The Ratnágiri farm trials showed that *marvel*, one of the very best grasses, yielded the best. It is also found that guinea grass if once established in the rains on the uplands survives the dry weather without irrigation and gives three or four bumper cuttings during and one or two months after the rains.

24. *Silage.*—On the varkas land sub-station near Alibág it has been found that good silage can be made in *kaccha* silos filled in October. The percentage of silage to green grass was about 40 per cent., out of which only about one-eighth was spoiled. Even this quantity can be reduced by employing pits of larger dimensions.

25. *Cultivated fodder crops.*—Out of the several crops tried, lucerne and berseem did well on both Alibág and Ratnágiri farms. At Ratnágiri, lucerne yielded at the rate of 37,000 lbs. per acre, in seven cuttings from November to May, and was easily sold off at 125 lbs. per rupee. It is reported by some customers that they could increase the milk supply of their milch animals by a ration of 10 lbs. of lucerne daily, while others economised their bills on concentrated food to the milch and cart animals by replacing it with lucerne. Berseem on both the farms yielded at the rate of 12,000 lbs. per acre in two cuttings. Maize and sorghum did not do well.

Development of Varkas Land.

26. Varkas land is the next important section of Konkan Agriculture after rice and especially assumes greater importance in the Ratnágiri District. At present the cultivation of these lands is in the hands of the most ignorant, unenterprising and poorest tenants, who grow some annual hill millets, which only provide them some food in return for the labour they have to put in. There are immense possibilities to develop such lands if better intelligence and capital is diverted to this section of Konkan Agriculture. Of the several directions of improvement, the following are some in which work has been started, and some progress made:—

27. *Embanking and Terracing.*—Cultivation of varkas lands without embanking and terracing has been the greatest defect. The evil effects of bringing the hill-sides under the plough under the heavy downpours of rains of Konkan are too obvious to need any mention. So this has been the main feature of the work that has been adopted at the varkas land sub-station at Bandhan, eight miles from Alibág. A gradual process of embanking and terracing is being practised and in two seasons a depth of 9 to 12 inches has been silted up at an annual cost of Rs. 2-8-0 per acre.

28. *Introduction of more remunerative annual crops—Groundnut.*—It has been established beyond any doubt that groundnut suits the varkas lands and climate of Konkan very well. The profits from this crop averaged about Rs. 34 as against Rs. 15 from *nagli*. Spanish peanut and Small Japan are the varieties that were tried. A distance of 12″ × 9″ has been found more profitable than a thinner one with these varieties. Other late and spreading varieties like Big Japan and Pondicherry were also given a trial and on fleshy soils have been found more paying.

Among other new crops tried, sorghum jowar and san for fibre have also been found more remunerative. Many others are under trial.

29. *Plantations.*—The most profitable utilization of these lands would, however, be by plantations such as mango, cashew nut, myrabolams, bamboos, timber trees, agave where no irrigation is available, and irrigated plantations like *chikus*, plantains, cocoanuts, betel palms, pine apples or annual irrigated crops where irrigation facilities exist or could be made available. This line will be gradually developed as facilities permit.

Garden Cultivation.

30. This is the next important section of Konkan Agriculture which is mostly restricted to the coastal belt and to the up-ghat portion of the Kánara District, where good irrigation facilities exist. The most important crops are cocoanut and betelnut, and plantains, betel vines, ginger, chikus, etc., in the West Thána where transport facilities and a good market of Bombay are available. Mango is another most important semi-garden crop that requires attention.

It has not yet been possible to provide for any systematic experimental work in this section, and advice was given on the basis of the results of experiments and experience obtained elsewhere.

Trial of new and Improved Agricultural Implements, Machinery and Appliances.

31. There is not much possibility of employing heavy machinery and appliances owing to the peculiar laying out of fields in very small blocks for rice cultivation and under the flooded condition of the fields in the rains when most of the tillage operations for rice are to be done. But the following small implements have been tried:—

Meston plough.—This suits most of the Konkan conditions. It draws a bit hard to the very poor of the Konkan cattle. It has been found necessary to make certain modifications to suit the same for turning sticky soils in a wet condition. The W. K. S. plough is much better in these respects.

Acme harrow.—A modified form of acme harrow was tried for pulverizing the clods in making the puddle. It is a promising implement.

Bulsár Rahat.—This is a water-lift made locally in the Surat District on the pattern of a noria. It costs Rs. 300 and wherever there is sufficient water for at least 3 rahats and enough land to utilize all the water lifted in a day it would be economical to use this lift. The size with one-gallon buckets requires two bullocks and lifts about 3,000 gallons per hour as against 900 gallons by one-bullock rahat.

Chatanooga No. 12 Sugarcane mill.—This was tried and found to be suitable to Konkan conditions and much superior to the wooden mill in vogue.

Special Problems under Investigation.

32. *Manat land Reclamation.*—In the Kolába District, there is a considerable proportion of flat low land along the sea and creeks which has a very clayey and sticky consistency and does not produce any remunerative crops. A plot of such land has been taken up near Alibág to investigate the methods of improving them. Deep tillage, drainage, and improving the texture by the addition of green matter in form of green manure crops, or coarse dry matter such as dried leaves, rice husk or by liming are being tried. Deep tillage is already showing up a slight advantage. It has not yet been possible to get a good growth of green manure crops. No appreciable effect is yet observed from the other treatments.

33. *Gul manufacture from palms.*—On the basis of the report of preliminary investigations made by Mr. P. C. Patil my predecessor an experiment on a large scale was undertaken by one Mr. Sorabji Patil of Tadgaon of Umbergaon Peta, Thána District, who was given all possible assistance by this Department. He has not been able to make good gul, chiefly owing to the newness of the work and difficulty of inducing the tappers to exercise the necessary care and cleanliness required in tapping unfermented juice. Experience gained by him, however, confirms the opinion expressed by Mr. Patil that the industry is only suitable for the labouring farmer as a subsidiary occupation to agriculture. Further work in finding out proper methods of tapping unfermented juice and organising the industry is necessary.

34. *Band disease of betelnuts.*—A disease called *band* is doing serious damage to betelnut in the Dápoli Táluka of the Ratnágiri District. A preliminary enquiry in association with the Assistant Professors of Mycology and Entomology was conducted. It is found that it is not due to any fungoid or insect disease, but the cause must be looked for into the soil which seems to affect the physiology of the plant. Experimental work will be undertaken next year.

35. Besides these many other problems, as saline inscrustations in the lands reclaimed from creeks, the possibility of utilizing for manure the offal from fish curing, packing and transport of mangoes and the like, have engaged the attention.

EXTENSION WORK.

37. This consists in introducing improvements into the actual practices of agriculture, and giving such advice and help as will make the agricultural industry in general more profitable. This work has to be principally done by the itinerant district staff. The following is a summary of the work done during the year in various directions :—

Agricultural Exhibitions.

38. Two were organized—one at Ratnágiri and the other at Bassein in the Thána District. These have been very effective in advertising the Agricultural Department, intensifying the interest in the improvement of agriculture and in bringing to the notice of the farmers, by way of demonstrations given therein, the improvements effected by the Department and people.

Demonstrations on the Farms and Outside.

39. The Agricultural stations serve as standing demonstration centres, and were visited by many agriculturists during the year.

A special demonstration was arranged on the Ratnágri farm in connection with the Ratnágiri Agricultural Exhibition which was attended by about 400 visitors. A special party of cultivators was brought to the varkas land sub-station at Bandhan where the results of work there, principally the advantages of terracing and the groundnut crop, were demonstrated. Two more plots for demonstrating groundnut were arranged at Koproli in the Kolába District and at Satgaon in the Thána District, where the cultivators from the surrounding localities were called and shown how successfully this crop grows on varkas soils. A party of a few intelligent leading cultivators representative of the four districts was conducted to Malkápur in the west of Kolhápur State where the typical system of cropping the bandhs of rice fields and careful cultivation of *nagli* and groundnut on varkas lands could be thoroughly brought home to them.

Itinerant demonstrations of the Meston plough in all the districts and iron mill and Poona furnace in the Ratnágiri and Kárwár Districts were given on an extensive scale.

The knowledge about the suitability of groundnut crop to varkas land has by the last five years' example and precept now spread to all the parts of the Konkan Districts, but owing to the damage done by jackals, crows and wild pigs in some quarters and concentration of attention on rice crop, it will be long before this new crop assumes prominence.

Red Mauritius variety of sugarcane and onion crop has been pushed in the Kárwár District.

Distribution of Implements, Manure and Seed.

40. Implements worth Rs. 1,500 were sold, which consisted chiefly of 60 Meston ploughs and spare parts, 11 Poona type of gul boiling pans, 3 iron mills, 6 iron levellers.

41. The most important items in the seed distribution, which were specially organised, were san, groundnut, onion seed and Red Mauritius sugarcane sets. The following statement details the quantity distributed of each :—

		Thána.	Kolába.	Ratnágiri.	Kárwár.
Sugarcane sets	..	....	....	....	25,000
Groundnut	lbs.	812	80	2,500	1,200
San	,,	450	..	2,832	1,500
Onion seed	,,	....	....	....	35

In addition to these, 400 lbs. Rascadum variety of paddy seed in Kárwár and 1,000 lbs. of the local variety from Alibág, guinea grass sets from the Ratnágiri farm and small quantities of vegetable and other sundry seeds were supplied.

42. Under the section of manure, the denaturalized salt at concession rate continues to be popular and permits for the following quantities were issued in the four districts :—

Name of district.	No. of permits.	Quantity of salt.
		Mds.
Thána ..	20	720
Kolába ..	11	199
Ratnágiri ..	76	1,457½
Kánara ..	127	1,448
Total ..	234	3,824½

Dissemination of Knowledge of Improved Methods in other ways.

43. Leaflets on Meston plough, Bandh crops and Rab substitutes were drawn up, and many articles and notes on local topics were published in the Agricultural College magazine, *Shetki and Shetkari* and local newspapers. The Agricultural Overseers were constantly touring and gave advice by short talks to groups of cultivators after personally examining the local conditions. Leaflets were freely distributed and many were induced to subscribe to *Shetki and Shetkari*. Various enquiries were answered by my office, the two farms and the four Overseers by correspondence.

Concession to Agriculturists.

44. In the Kárwár District it has been arranged to give free posts from the forests for wire fencing and to supply fuel for gul boiling at Re. 0-1-0 per guntha to those who will use the Poona furnace. A buffalo bull of pure Surti breed has been bought and maintained on the Alibág farm, the service of which is allowed to the neighbouring agriculturists at Re. 0-8-0 for each buffalo served. During the four months since the buffalo was purchased 24 buffaloes were served.

Agricultural Associations.

45. The Honávar Agricultural Association has continued its exertions in promoting the agriculture of the táluka ; it has pushed the spread of Poona furnace, and iron pans, Red Mauritius variety of cane and surgical castration ; it has tried some new varieties of paddy for deeply submerged fields ; greatest credit is due to the energetic Secretary Ráo Sáheb Basrur who may perhaps be said to be the only active worker of the Association and who has placed his farm at the disposal of the Association for demonstration and experiment for which he defrays all the expenses himself. The Kumta Association have continued their various activities, which are mostly on the same lines as those of Honávar. The Sirsi Association have distributed 10,000 sets of Red Mauritius variety of cane. The Alibág District Association held a conference in

which improvement in rice cultivation, the scope for extension of groundnut cultivation were discussed and resolutions adopted. The Panvel Táluka Association distributed denaturalized salt and organized a groundnut crop demonstration. Some of the members of the Umbargaon Peta Association have tried silage, and have taken up the cultivation of garden crops, such as sugarcane and ginger, which are quite new to the tract. The Ratnágiri District Association organized an Agricultural Exhibition at Ratnágiri and its Devgad Táluka Branch has adopted a definite programme of operations to be done by the individual members. The remaining Associations have not reported any work. It has been noticed that whatever work has been represented above is in most cases the results of activities of single individuals—the Secretaries. Other members, on the whole, do not seem to have realized the importance of such Associations and are not taking much interest. Efforts were made during the year to meet most of the Associations, indicate to them the lines of work they could adopt and draw up programmes for some.

AGRICULTURAL EDUCATION.

46. Sardár P. K. Bivalkar's school at Veshwi (Alibág) has proved beyond any doubt the possibility of introducing the teaching of subjects leading to agriculture in the primary schools of the rural areas without in any way interfering with the usual curriculum of the primary schools. The only additional provision that will be necessary is some premium to a properly selected trained teacher who will also be given a course of agricultural training at an Agricultural school like Loni, and a school farm which can be made self-supporting.

An Agricultural school at Jambul, Táluka Kalyán, District Thána, on the type of Loni school has also been sanctioned by Government; buildings have been taken in hand and it is hoped that the school will begin from next April.

AGRICULTURAL SURVEY.

47. The various members of the staff during the course of their tours for extension work or with the special object of studying have continued to collect information on local conditions and practices, to find out defects and to investigate new possibilities. The information when complete is collected into notes and published, or forms the basis of future experimental and extension work.

V. G. GOKHALE,
Extra Deputy Director of Agriculture, Konkan.

APPENDIX G.

WORK DONE UNDER THE PROFESSOR OF AGRICULTURE, POONA, 1915-16.

I.—Introductory.

The Professor of Agriculture has supervisory charge of the Mánjri Sugarcane Station, the Agricultural College Dairy, and the College Farm in addition to his duties as Professor in charge of the teaching of agriculture, both practical and theoretical, at the College. Besides carrying on research work, these farms serve both for education and demonstration and are used as depôts for the distribution of agricultural supplies.

II.—Research Work.

Sugarcane.

When the study of the sugarcane crop in the tracts under irrigation from the canals in the Deccan was begun it was found that the cultivators, while producing very heavy outturns of gul, did so at a great expense of labour and manure and that they used very heavy applications of water. Improvement along all these lines has now been effected to a considerable degree. These improvements have been adopted by the more enterprising cultivators and there is a fair prospect that the cultivation will be entirely revolutionised in a few years.

In order to save labour which has nearly doubled in price within the last few years in the irrigated villages, a system of planting which enables much of the hard labour to be replaced with bullock power has been worked out.

The first thing was wider planting, so that bullocks could pass up and down between the rows. The distance between the rows is now kept at five feet with no cross *bándhs*, as opposed to the local method of 2½ feet distance and cross furrows every 10 feet. The cane is planted in furrows of the usual depth (about 6″), the sets being placed end to end. These furrows should be as long as possible and cross furrows only made wherever the slope demands.

Planting in this way gives as large outturns as by the old method. The average outturn at our farm by this method during the last two years was 12,154 lbs. of gul as compared with 10,600 lbs. of gul, the average of the plots planted by the old method. But the great advantage claimed for this system is not higher outturn but reduced cost of production. Hand weeding which by the narrow row method costs some Rs. 25 per acre is almost entirely eliminated since the rows are intercultured with the blade harrow, the tooth cultivator and the ridger. Any weeds left are hand picked. The total cost of all these operations does not exceed Rs. 5 per acre. The work is done opportunely and not delayed on account of labour scarcity.

When cane is 5 to 6 months old it is earthed up. By the old system this is usually done by contract at about Rs. 10 per acre. We are able to earth up in the new method with the *sabul* plough with a tail sheet, doing an acre daily, which costs only Rs. 2. This can usually be done with the regular farm staff of men and bullocks and does not mean a cash outlay to the farmer, while the fact that the time of performing the operation is wholly within the owner's control adds to its utility. While labour is the main item we are trying to reduce, it has been found that the new method has several advantages, *viz.*, :—(1) It requires only about 70 per cent. of the irrigation water that cane planted by the old method uses. (2) There is a saving of sets required for planting of over half the usual number, due to the less number of rows ; since the thin planting so favours the development of tillers that the same number of canes per acre is obtained. (3) It is believed that there will be a considerable economy of manure effected. Nearly one thousand acres have been planted by this method on the various canal tracts of the Presidency.

Experiments to determine the minimum number of sets that would give good results have been conducted along two lines. The first, by the proper placing of the sets in the furrow so that the eye buds shall come at the sides, as it is found that when any of the buds are left on the underside they never fully develop. The second line of work has been the determining of the proper portion of the cane to be used for sets. It has been demonstrated beyond any doubt that sets from the upper third of a stalk of sugarcane will germinate quicker, more perfectly and produce a better crop, whereas the lower portions contain more sugar so that they are more economically used if crushed and made into gul. The upper sets will usually be freer from any disease than the older portions of the stalk.

The Java method has been continued and has proved itself useful under certain conditions. It is more suited to heavy and deep soils. The water is required only for five months and the applications even then are very light though frequent. The frequency of watering would make it prohibitive under the present irrigation systems but where there is well or lift irrigation it would no doubt pay very well. The outturn obtained of 9,000 lbs. of gul is high for the soil where the experiment was made. In this method no coarse manure was used and only 400 lbs. sulphate of ammonia per acre were used. A little modification of the manuring might increase the outturn.

The hard varieties of cane are better adapted to this method than the softer ones. First ratoon from this method is equal to plant cane. The great objection to the method is the cost of digging trenches 2 feet wide by 1 foot deep. An attempt to secure part of the benefits of the Java method combined with the new Mánjri farm method is giving good results. In this method deep furrows are opened with a heavy ridging plough.

In manuring sugarcane the two purposes served by manure have to be kept in mind, the maintenance of the structure of the soil by adding coarse organic manure to furnish humus and the supply of plant food principally nitrogen. Farmyard manure is the most common source of organic matter, but the supply of this manure is deficient in the irrigated tracts. In the vicinity of Military stations where there are numerous horses and mules the stable manure furnishes a valuable source of coarse manure, which has been proved superior pound for pound to farmyard manure.

When gul is made by the improved furnaces a considerable quantity of dry leaves (trash) can be saved and turned to account for manure and is equal in value to farmyard manure. The substitute for farmyard manure most widely available is a green manure crop. *San* (Crotalaria juncea) has been used for this purpose and this treatment puts the land in a better condition than farmyard manure, but it precludes the possibility of taking a kharif crop like groundnuts before the cane.

Among the manures furnishing plant food, sulphate of ammonia and nitrate of soda are proved of equal value and superior to oil cake. They are most useful when used in combination with cake. We are now using a dressing composed of two hundredweight of ammonium sulphate or three of nitrate of soda, six hundred pounds of good fish manure and eight hundred pounds of safflower cake. It is wiser to apply the minerals in two dressings, especially the nitrate.

The area devoted to planting cane every month in order to always have cane in all stages for demonstration has given us some interesting results, *viz.* :—that the variety Pundia in Poona requires full 13 months to ripen when planted in January or February. When planted earlier this period is lengthened to 14 or even 16 months.

The variety work is not yet far enough advanced to give many practical results, but we have two or three early canes which if their yield and composition keep up on a large scale to what they promise now, they will be very valuable, especially in some places such as the Konkan.

Cotton.

Varieties (Varadi).—Only the white flowered varieties (Gossypium neglectum. Var. rosea) were grown on any considerable scale, and these are not strictly comparable since the broad lobed (Gossypium neglectum. Var. rosea Cutchica) was manured with five cart-loads of farmyard manure, to cotton crop, in the cotton-jowar rotation, whereas the narrow lobed (Gossypium neglectum. Var. rosea proper) came in the section of the same rotation, where the same amount of manure is applied to the jowar ; but even taking this into consideration the differences in their yields are worth noticing, the broad lobed giving an average of 1,175 lbs. of seed cotton as opposed to 1,105 lbs. of the other. In ginning percentage however the broad lobed type this year in these plots is 2½ per cent. lower which makes the yield of lint about even. This difference in ginning percentage is much greater than in the selection plots. In the selection work the white flowered strains are showing steady improvement.

Broach cotton did not give its usual yield so that the growing of it with mixtures was more profitable, small groundnut being the most profitable secondary crop, with til and rice about equal.

Cambodia and Buri do not promise very much in this region.

Manures.—The experiments with artificial manures have demonstrated that nitrate of soda and ammonium sulphate increase the yield of cotton but not in an amount in any way commensurate with the extra cost of the salts.

Farmyard manure applied to cotton is demonstrated to be worth nearly Rs. 2 per cart. Neither phosphoric acid nor potash manure have behaved at all promising as cotton manures. If a small quantity of farmyard manure is available for a jowar-cotton tract, it has been found in experiments extending over four years that it can be more profitably applied to the jowar than to the cotton.

The value of separating heavy seed from light for sowing purposes has been demonstrated for four years. When the seed is so separated by means of the implement, devised by the late G. D. Metha (bulletin No. 53), there has been an average gain of nearly 30 per cent. in outturn at a trivial cost.

Jowar.

Work with this crop consisted of varietal, cultural, selection and manurial experiments. The four typical varieties of the Presidency—Perio, Gudgi, Gidgap and Fulgar Yellow—have been grown for four years for comparison. Perio is by far the largest yielder of these, having

produced in one case over 2,000 lbs. of grain. But the fodder is coarse and inferior though the grain is of good quality. The other varieties come in the following order :—Gidgap, Fulgar Yellow and Gudghi.

The cultural experiments had reference to spacing, intertillage and seed grading. The narrow interval between rows in one case has given considerable more outturn and in the duplicate about the same as the wide spaced plot. But this experiment should be considered together with the next, because thorough intertillage is impossible when the rows are so near that the intertillage implements cannot be passed through the rows when the crop has made a considerable growth. The value of intertillage has again been strongly demonstrated since the plots produced 22 per cent. larger crops than those not intertilled. As in cotton, the value of heavy seed for sowing has been demonstrated, since the plots sown with seed, from which all seed lighter than water, had been excluded gave an increase of 50 per cent. in yield.

A start has been made in trying to produce strains of shalu jowar that are more prolific.

In the manurial experiments, nitrate of soda has increased the outturn to a paying extent and much more markedly in the presence of farmyard manure. The superphosphate has reduced the outturn while potash has improved it.

Groundnut.

In the test of variety Spanish peanut has done better than Small Japan. If this result is borne out by continued trials this variety should be chosen for introduction where the rainfall is scanty rather than the Japanese variety mentioned last year. The Big erect this year has not yielded as well as last year. Possibly certain changes in cultural methods are necessary to obtain the highest yield from this. Because of the cost and trouble of shelling groundnut it was thought worth while to try sowing the unhusked pods. In one test last year a fair yield was obtained, in the other one and in both plots tried this year the nuts not husked gave a less yield. I attribute a part of this to the fact that it was not possible to separate out diseased nuts when they are shelled, which was not possible in the unhusked seed. The cost of shelling is not a great charge (Rs. 2 per acre), so that until a method of separating light kernels in the pod is devised it is better to shell the seed.

The manurial experiments with this crop have yielded very little satisfactory results. On very light soils the crop profits by nitrogeneous salts. The potash plots give rather inconsistent results but in the majority of cases show decided gain from manures of this class but never sufficient to pay for sulphate of potash. Perhaps some cheaper form of this element like ashes might be profitable.

The experiments show that even as a dry crop this plant requires considerable organic matter to produce a good crop, since five loads did not give as paying an outturn as the larger dressing of ten loads.

Bajri.

The pulse mixtures verses rotation experiments tried with this crop are all in favour of the mixtures, which is in accordance with the country practice. Of the various methods in vogue of sowing tur with this crop in different tracts it has been found that the Poona system of sowing tur in every fourth row, thereby permitting of intertillage after the harvest of the bajri which destroys weeds and conserves the moisture, is the best system.

The spacing experiments here as with jowar must be considered only with reference to the better facilities for interculturing given by wider planting and this in its turn depends upon the distribution of rainfall as to whether intertillage is necessary or possible. Last year's figures were in favour of narrow rows but this year the opposite results are obtained. A study of the most profitable method under our varying climatic conditions is necessary to determine which system is best in the long run.

Potatoes.

Potash both last year and this year has not increased the outturn but safflower cake has brought up the yield in both years by an average increase of nearly 800 lbs.

Gram.

Kabuli while producing a less yield than the local variety is more paying owing to higher price which it fetches.

Chillies.

Potash as sulphate has not increased the yield of this crop.

Tobacco.

Potassium sulphate has increased the outturn of this crop but not sufficient to pay for the manure.

Onions.

Sulphate of ammonia has again proved to be a paying manure for this crop.

The plots planted by the ridge system gave from 25 to 50 per cent. greater outturn but the quality was a little coarser.

Wheat.

Green manuring with various crops as compared with kharif cropping and fallowing has been tried with dry crop wheat for several years. From the results of all these experiments we can draw the following conclusions :—

(1) Green manuring is 20 per cent. better than fallowing.

(2) That apparently a leguminous crop is no better than plants of other orders for this purpose.

(3) That green manuring is 37½ per cent. better than taking a kharif crop so far as the yield of the wheat is concerned.

III.—Education.

From the fact that the farms under me are all located near the Agricultural College, in which I am the Agricultural Professor, one of the main functions of these farms is to serve as aids in teaching Agriculture. Even much of that part designated in this report as research to a certain extent deals with the results obtained in teaching experimentation to the students. During the first year the introduction into the principles which govern the use and construction of implements, both indigenous and introduced, are given to the student until he becomes proficient. In the second year the entire cultivation of the crops on an area of one tenth of an acre is carried out by each student, whereby he learns all the details and difficulties of crop production. Having acquired skill in the use of implements and a working first hand knowledge of the practical growing of crops, last year's work on the farm is devoted to the principles of field management, the methods of carrying on experiments, and the recording and the interpretation of results. An attempt is made to familiarize the student with cattle management and give him the rudiments of dairying by attendance at the Dairy farm. Intensive agriculture and the manufacture of gul are taught at the Sugar Station at Mánjri.

Besides the regular College classes leading to University degree, a short course (in English) in agriculture was carried on during the year under report. A special class was conducted in vernacular in sugarcane cultivation and gul making at Mánjri Farm. This was attended by 45 men, most of whom were actual cultivators. A class in poultry husbandry was held at the poultry branch of the Dairy.

Besides these regular classes, instruction and training were given during the year to eight Kamgars who went out to take charge of work in the district. There have been three Graduates posted on these farms for further training during the year.

IV.—Demonstration and Shows.

During October the District Officers sent fifty cultivators daily for a period of 21 days to study the improved methods of crop production in vogue on these farms.

Assistance was given to shows held at Chopda, Sindkheda of Khándesh, at Jamkhindi in the Southern Marátha Country and Ratnágiri and Bassein in the Konkan.

Demonstration of implements and talks on practical agricultural subjects were given at the rural meetings held by the Deccan Agricultural Association.

The new method of planting cane was demonstrated by men sent out from the Mánjri Farm at Bárámati and Sholápur.

Besides these regular organized efforts of demonstrating our results to the public, the farms have now become so well known that they are visited almost daily by cultivators who come singly or in groups to learn the improved methods.

V.—Distribution of Agricultural Supplies and Assistance to the Public.

The farms are being carried on to help the cultivators in every way possible and act as depôts for distribution of improved implements, seeds and artificial manures and bureaus for sending out trained workers like gul boilers or for petty repairs of implements.

The public appreciate having a place where seed which has been carefully cleaned and graded and its germination tested and as far as possible grown from improved and pure strains is available. The artificials distributed are of guaranteed compositions which prevents the buyers from going to unscrupulous dealers in such matters. The implements are kept in stock by several firms and sent out properly put up and adjusted. Only approved implements suitable to the purpose and localities for which they are intended go out.

Gul making apparatus like sacharometers for testing ripeness, crushers and boiling pans are supplied all over the Presidency.

Workshops are maintained at each farm where petty repairs to implements of the public are made and improvements carried out. Mánjri Farm has devised a very useful one-bullock-yoke and a toothed cultivator suitable to the new method of cultivation of sugarcane.

VI.—Spread of Agricultural Information by Printed Matter.

The Assistant Professor of Agriculture and the Superintendent of College Farm to a very large extent are responsible for the contents of the Maráthi journal published by the Deccan Agricultural Association. Leaflets on the use of the sacharometer and a bulletin on seed available on College farm were written by the staff of the farms.

Both as Superintendent and as Editor of Shetki and Shetkari the Superintendent of College farm has a large correspondence with cultivators and answers numerous queries direct, while many enquiries regarding sugar and questions relating to dairying and poultry keeping are attended to by the Superintendent, Mánjri Farm, and the Manager of Dairy farm, respectively.

VII.—Animal Husbandry.

The College Dairy at Kirkee is the principal head-quarters for work in this line. This institution serves for teaching the rudiments of dairying and cattle management. The location and size of the Dairy are in the way of making it a money making institution. Several of the various races of cattle found in India have been under observation here for 27 years and the characteristics of each are well known. The Adens give a quantity of milk but these animals are more suceptible to contagious diseases than others. The Gir or Suratis are better adapted to more moist regions. The Sindhis when first brought here do very well for one or two periods after which they frequently give very much lower yields. Home bred heifers give on the whole higher yields than their mothers. Both Surati and Delhi buffaloes do quite well in Poona but like the Sindhi cows they also are liable to degenerate after a few years.

Representative types of most of the cattle found in the Presidency are kept on the farms for instruction. A small poultry section was opened a year ago and two imported breeds are being tested. Some attempts have also been made at grading of the country fowl by crossing with cocks of the imported breeds. Artificial incubation and rearing are also being studied with reference to their application to Indian conditions.

J. B. KNIGHT,
Professor of Agriculture.

APPENDIX H.

REPORT OF THE AGRICULTURAL CHEMIST FOR THE YEAR 1915-16.

1. The office and laboratory of the Agricultural Chemist to the Government of Bombay have been under my charge for all the year except from April 1st to May 29th, 1916 when I was on privilege leave. During this time Dr. W. Burns was in acting charge of the work.

2. The routine analytical work of the laboratory was about normal, and has remained nearly constant now for several years. The following table gives the number of samples examined during the last two years :—

1914-15	..	1,560
1915-16	..	1,658

3. The character of the analyses done is shown in the following list for the current year :—

Nature of Samples.		Numbers.
Soil	..	327
Manure	..	177
Feeding Stuff	..	227
Water	..	488
Gul and Sugar	..	8
Oilseeds and oil	..	88
Dairy Products	..	36
Fruit	..	84
Strata of Boring Wells	..	121
Miscellaneous	..	102
		1,658

4. I have always maintained that the real test of the success of the laboratory in filling a public need is best shown by the use made of it by the public, both by actual cultivators and by those responsible for industries directly dependent on agriculture. The number of samples received for analyses from the public as distinguished from those from Government farms and departments continues large, and was as follows during the year under record :—

Nature of Samples.		Numbers.
Soil	..	148
Manure	..	101
Feeding Stuff	..	103
Water	..	67
Gul and Sugar	..	1
Oilseeds and oil	..	25
Dairy Products	..	16
Miscellaneous	..	97
		558

5. The character of the work has differed little from that in the previous year, but there are a few special matters which have come up during the period that merit mention. In these semi-arid regions perhaps the most frequent inquiries made are as to the suitability or otherwise of samples of waters for irrigation. Nearly five hundred samples of water have in fact been examined during the year. In this connection I am co-operating with the Executive Engineer for Irrigation, Poona, in further investigations as to the sources of salt, and the methods of getting rid of it in the land under irrigation in the Nira Valley. A good deal of discussion has arisen on this question since the report of Mr. W. W. Smart two years ago, and the questions involved, which it is vital to understand if adequate protective measures are to be devised, can only yield to a very careful local investigation with examinations of large numbers of samples.

6. In connection with the use of water for irrigating rice land, a very interesting question was raised last year by the Extra Deputy Director of Agriculture, Konkan, with regard to the necessity of renewing the water in the rice fields every week or so. The cultivators say that if this is not done the water becomes " hot ". This was shown to be associated with a very large increase in the organic matter present in the water and especially in its acidity. This latter increased more than tenfold in samples sent to me. This is not the only case of the development of acid in lands in the rice districts of Western India, and one or two other cases of it are now under investigation.

7. The whole question of the underground waters of the trap area of Western India, their nature, the origin of their salts, and the distribution of the water streams is one of very great importance. Work in testing the value of the automatic waterfinder has continued through

the year, and a new waterfinder has just reached me. A bulletin has been issued on the results thus far obtained (Bombay Department of Agriculture, Bulletin No. 72), and the conclusions reached are thus stated :—" It would seem, however, sufficiently proved that under the conditions which prevail in the trap regions of western India, where underground water occurs in well defined streams flowing in rock fissures, ... the automatic waterfinder can be used with advantage in locating streams of water which can be tapped either by well-digging or by boring. The method of working the instrument needs a great deal more investigation and the instrument itself does not seem in anything like a perfected condition. But if results such as have been obtained in my experiments can be obtained on a larger and wider scale, the instrument will undoubtedly be of very considerable use in regions like the Deccan in which the people are dependent to so great an extent on sub-surface supplies of water flowing in fissures in hard rock."

8. Another bulletin embodying the result of six years' study on Well Waters from the Trap Area of Western India (Bombay Department of Agriculture, Bulletin No. 74) was also issued during the year. This embraced a systematic examination of waters from typical wells in the Deccan and in Gujarát for a long period. The matter has been further continued in another direction by the publication of two papers by Mr. S. R. Paranjpye and myself on (1) the waters of an exceedingly interesting series of Intermittent Springs at Rájápur in the Konkan, and (2) the Hot Springs of the Ratnágiri District (Journal Bombay Branch Royal Asiatic Society, 1915 and 1916). All these promise to form parts of a solid foundation for an understanding of the decomposition of trap rock and the composition of the waters on which most of the irrigation of western India depends.

9. There is little to report new in the matter of work on manures. No new materials for use as manure have appeared on the market during the year, but the price of oilcakes for manure has remained lower relatively to those of artificial manures than was the case before the war.

10. I have continued and undertaken a considerable number of experiments during the past year in the use of artificial manures for our leading crops and particularly of potash manures, superphosphate, nitrate of soda and sulphate of ammonia. For experiments with nitrate of soda a subsidy has been received from the Chilean Nitrate Propaganda. The work has been in progress for four years, and has been immediately under the control of my assistant Mr. S. R. Paranjpye. The definite results of this inquiry have been published during the year as a bulletin of the Department of Agriculture, Bombay (Bulletin No. 76). These results are very striking, and with tobacco in the Deccan, potatoes in the Deccan, sugarcane, lucerne, and plantains (bananas) recommendations have been made which promise exceedingly good results. These experiments are being continued.

11. I acted as a member of the Government Committee on the Milk Supply of cities during the year, and have also, with the consent of Government, been making inquiries on behalf of a Committee of the Bombay Corporation in connection with the question of Milch Cattle Stables in Bombay. With regard to this latter, I am at present preparing my report for submission to the Corporation Committee, which will, I hope, be ready by August 1916.

12. Samples of *ghee* continue to be received for analyses which consist almost entirely of goat's fat. This fact shows how urgent is the question of adulteration in connection with this material. It is, of course, difficult to detect a small adulteration, but most of those which have been through my hands are not slight adulterations but ones in which the greater part of the material consists of other fats, generally goat's fat.

13. My laboratory has investigated a number of samples, for which we were specially equipped, on behalf of the military supply departments in connection with the war, and of other departments as well. These illustrate very clearly the extent of adulteration which goes on in many classes of material. Some examples may be given.

(a) Tent sulleetahs supposed to be made of hemp were found to have the woof entirely composed of jute, while about half the warp was flax, the rest being the so called Deccan hemp or Bimlipatam jute (*Hibiscus cannabinus*). In another case four samples of cloth intended for tent sulleetahs were sent to me. Of these two were entirely composed of flax, as should have been the case. In the other two cases the warp only was flax, the woof being jute.

(b) Coffee has been very seriously adulterated during the last year with *kuvadia* seed or *Cassia tora*. A sample of one large consignment was sent to me which had at least twenty-five per cent of the seed. As the detection of this adulterant depends on microscopic examination, the quantity could not be more exactly determined. One cannot say that this adulterant is actually and directly injurious in food, but any material which contains it cannot be counted as in any sense pure coffee.

(c) Artificial carraway seeds were sent to me in November last by the Government of Bombay. These were entirely composed, apart from mud and dirt, of the seed of *Andropogon squarrosus* or *khus khus* grass, and it is evident that this latter is used extensively as an admixture with carraway. It is wholly without value for the purpose for which carraway seed is used.

(d) Recently some samples of artificial saffron reached me. These were composed of the young dried seedlings of *matki* (*Phaseolus aconitifolius*) coloured with a coal tar dye whose nature I have not yet been able to ascertain.

These are just a few illustrations. India is probably full of just such adulterations, which perhaps come more to the fore at times like the present.

14. No new feeding stuff has come on the market this year, but several enquiries with regard to injury to cattle from foods have come to hand. One of these was from the Military Dairy at Ruk, Sind, and after examination of all the feeding stuffs which were used I came to the conclusion that the most probable source of injury was from a so-called rice dust. This evidently consisted of the sweepings of a rice mill, and contained very much rice husk and no less than 16 per cent of sand. Rice husk is not usually fed to cattle at all, being said to produce tympanitis, and hence such a material is highly dangerous and any similar material should be carefully avoided by all who have to feed cattle.

Another case of perhaps greater interest is one which was brought to my notice by the Veterinary Officer in charge of the Dispensary at Godhra. In this case buffaloes after feeding on a certain pasture, became affected with 'sleepy staggers.' The only plant in the pasture at all likely to cause the attack was *Vinca* (*Lochnera*) *pusilla* or *singia*, and it was actually attributed to this by the local ryots. Its injurious character has been noted in South India many years ago, and that of the allied species *Vinca minor*, and *Vinca rosea* has been noted in Java, where these are said to be liable to cause dizziness. It is interesting to have attention drawn again to the danger of this plant, about which very little indeed seems to be known.

15. The war has brought about many inquiries in directions in which they were never made before. These have included the examination of local deposits of china clay with requests for information as to how these could be decolourised, inquiries as to the value of local deposits of gypsum, requests for information regarding the decolorisation and deodorisation of oils, investigations as to the preparation of paints with safflower oil, &c. One of these matters is worthy of note. Indigo is being again grown in Khandesh, and if the war continues it will soon be grown on a large scale. The indigo produced, considering the temporary and primitive arrangements made, was very fairly good. One sample from Farkanda (Khandesh) gave the following analyses

Moisture	.. 7.1	Indigo red	.. Trace.
Indigo blue	.. 49.2	Ash	.. 26.3

Other samples gave comparable figures.

16. These are just a few of the special matters that have been before my laboratory during the year. Beyond these, a considerable part of my staff are engaged in investigations which have occupied their attention for a long period. A second memoir on the chemistry and physiology of the betelvine leaf has been published during the year (Memoirs of the Department of Agriculture in India, Chemical Series, Vol. II, No. 7) and the work for a third and final one is being vigoroulsy pushed forward by my assistant Mr. V. G. Patwardhan. Papers on safflower oil, on buffalo milk, and on the conditions of spice garden cultivation in Kanara merely await the time to put them in form for publication. A bulletin on Fodder Crops in Western India is in the press; this deals in an exhaustive manner with the present position of the subject. The members of my staff are assisting in investigations on scented rices inaugurated in the Economic Botanist's Department, and in further inquiries regarding the poisonous character of young *jowar* plants.

17. My staff has worked well during the year. Mr. V. A. Tahmane, B.Sc., L.Ag., has remained Senior Laboratory Assistant throughout the year. The services of one member of the staff (Mr. D. D. Abhyankar, B.Ag.) has been lent to the Sanitary Department for the whole year, and of another (Mr. V. J. Atgur, B.Ag.) for part of the year. Mr. N. R. Gurjar, B.Ag., has been detailed for special work with the waterfinder, and Mr. S. R. Paranjpye, B. Ag., is in charge of the district work on artificial manures which is under my control.

HAROLD H. MANN,
Agricultural Chemist to the Government of Bombay, Poona.

APPENDIX I.

WORK DONE UNDER THE ECONOMIC BOTANIST FOR 1915-1916.

ENQUIRIES.

There has been a considerable increase in the number of enquiries of all kinds received and answered. It is gratifying to find that all classes of people consult us. For example, cultivators in out-of-the-way villages scribble questions in the vernacular on post cards and send it for a reply, which they never fail to receive. On the other hand, the Economic Botanist and his staff have been called in to advise in larger matters of public importance such as the treatment of canal weeds, the renovation of pastures, the valuation of fruit plantations in legal cases, and the lying out of demonstration fruit plots for Agricultural Associations. In addition to those who enquire by post, there are many who pay a personal visit either to the Economic Botanist's office or the Ganeshkhind Botanical Garden, to discuss matters verbally. The following table shows the number of enquiries dealt with by post. Each number refers to a complete correspondence and not to single letters.

Subject.	Number in 1915-16.	Number in 1914-15.	Number in 1913-14.
Entomology ..	9	....	....
Botanical advice ..	90	37	9
Citrus ..	22	24	13
Diseases ..	74	73	43
Enquiries (miscellaneous) ..	75	44	78
Arboriculture ..	8	....	....
Fibres ..	14	....	....
Grapes ..	15	12	30
Horticulture (general) ..	38	57	4
Konkan Horticulture ..	8	19	2
Identification of Plants ..	32	28	23
Manures ..	5	12	3
Mangoes ..	7	30	30
Plants & Seeds supply ..	76	87	82
Plantains ..	3	6	3
Personal ..	18	26	6
Rubber ..	1	5	7
Sericulture ..	....	1	2
Sugarcane ..	2	3	7
Supply of specimens ..	14	7	19
Seed Testing ..	79	47	28
Teaching ..	2	13	6
Weeds and Grasses ..	22	14	21
Wheat ..	....	6	5
	614	553	424

EDUCATION.

The following pupils underwent special training in the Ganeshkhind Botanical Garden :—

Name.	Town or village.	Subject.	Period of training.
1. Kedu Satu ..	Dhulia ..	Horticulture ..	May 4, 1915 to February 7, 1916.
2. Masalawala ..	Poona ..	Do. ..	May 4, 1915 to February 29, 1916.
3. Kanitkar ..	Poona ..	Do. ..	May 4, 1915 to September 30, 1915.
4. Chhapgar ..	Poona ..	Do. ..	May 1, 1915 to February 29, 1916.
5. V. S. Kulkarni ..		Fruit culture ..	October 16, 1915 to November 29, 1915.
6. S. L. Patel ..	Poona ..	Do. ..	January 9, 1916 to March 31, 1916.

The usual training was given to students of the College of Agriculture. The students of the Training College for Men also visited the garden occasionally.

The Arboricultural course for Public Works Department subordinates was again given by Mr. H. P. Paranjpye, B.A., with the assistance of Messrs. S. L. Ajrekar, B. A., and Ramrao Kasargode. This year, a short training in horticulture, especially bungalow gardening, was given in addition to the arboricultural training. The class was enthusiastic and the knowledge acquired satisfactory.

One student, a B. Sc., has elected to work for his M. Sc. degree under the direction of the Economic Botanist.

Lectures and Publications.

Magazine Articles.

Article.	Author.	Magazine.
The Improvement of Natural Grass Land in India.	W. Burns, Economic Botanist.	Agricultural Journal of India, July 1915.
A Working Model of Mendelian Inheritance.	Do.	The Journal of Heredity, August 1915.
The Aquatic weeds of the Godavari and Pravara Canals.	Do.	Presented to the India Science Congress; to be published in Agricultural Journal of India.
The Classification of Mango varieties.	W. Burns and S. H. Prayag, B. Ag. Graduate Fieldman.	Agricultural Journal of India, October 1915.
Botanical Names	H. M. Chibber, M.A., Assistant Professor of Botany.	Bombay Natural History Society's Journal, 1916.
	Do.	Agricultural College Magazine, October 1915.
The Sale of the Mango Crop in the Bombay Presidency.	S. H. Prayag, B. Ag.	Do. do.
Variation in the Flowers of the Papaya.	L.B. Kulkarni, L. Ag., Graduate Fieldman.	Do. do.
A Word of Advice to Fruit Growers.	Do.	Do. March 1916.
Jamaica Orange, a new Citrus Fruit in the Deccan.	G. B. Patwardhan, B. Sc., Superintendent, Ganeshkhind Garden.	Do. January 1916.
An Intelligent Cultivator's Citrus Nursery.	Do.	Do. do.
The Necessity of Improved Methods of Grafting.	P. G. Joshi, Superintendent, Bassein Garden.	Do. do.
The Betelnut Palm (Areca Catechu) and its cultivation in North Kánara.	M. V. Kelkar, Fieldman, Ganeshkhind Garden.	Do. July 1915.

An illustrated bulletin on wild fodder grasses is in the press and will be published shortly.

Lectures have been delivered at exhibitions and public gatherings as usual.

Research and Demonstration.

Careful records of various grafted **mango** plants show that although the plant may flower at any time after the operation, setting of fruits occurs, as a rule, only after a lapse of from 4-6 years. This is not on account of defective pollination. We believe it to be due to the fact that the scion has to develop a very close union with the stock before fruits can be effectively nourished. All attempts to force the mango tree to flower at unusual seasons have failed. Methods which succeed with the orange, guava, and custard-apple fail with the mango. The flowering of the mango seems to be a matter of internal rhythm, practically independent of external circumstances. It is now proved that mango trees can be efficiently protected against fruit-fly by trapping the latter on basins covered with a mixture of linseed oil and resin, using extract of *tulsi* (*Ocimum sanctum*) as a bait.

Mango canning was successful in a fair percentage of cases, but many of the cans were faultily soldered and hence their contents did not keep. "Exhaustion" *i.e.*, heating at boiling point with the vent-hole of the can still open seems to be an essential part of the process as cans prepared without it were all slightly bitter. The keeping of mango fruits was again studied. Last year's observations, that the stalk scar was the point of infection by putrefying bacteria, was this year confirmed. Covering the scar with melted paraffin wax proved useless. Fruits keep longer when suspended in air in muslin bags than when laid in straw.

In the case of **oranges,** the most important problem attacked is the question of cultivation of orange plantations. *San* hemp plus bone meal has proved useful, combined with correct pruning. The orange *must* be severely checked by drought in some soils or no flower ing results. Previous results of stock testing are confirmed.

Guavas have been the subject of much experiment especially as to pruning and training. We are trying to grow the guava on horizontal wires and develop fruiting spurs thereon, as in the vine. Other trees are being trained into open urnshaped low-headed plants. Pruned trees gave from four to eight times the yield of unpruned trees. An attempt is also being made with some success to force the guava and the custard apple to fruit in the hot weather, when the market is most favourable.

Crosses were made last year to get a race of **papaya** with a large percentage of female trees. The first generation from these crosses is now coming into flower and fruits. Propagation of papaya by cuttings is being tried on a large scale. If this is successful, it will do away with any uncertainty as to what kind of tree (male or female) will result from a planting, since cuttings breed true to the plant whence they were taken.

Manurial experiments were carried out on **grapes,** without conclusive results, as yet. Against mildew the following spraying mixtures were used (1) Bordeaux mixture, (2) Potassium sulphide solution, (3) Ammonium carbonate and copper carbonate solution. The last named is specially useful for spraying the berries as it leaves no stains on the fruit.

An attempt is being made to get two crops of **figs** in the dry season instead of the one now got. To do this it has been found necessary to prevent the tree ripening the unprofitable rains crop, and to concentrate its energy on the dry weather crops. This is effected by removing the rains fruits as they appear and by judicious pruning in October and in January. A mulch of leaves in November was found positively harmful to figs, inducing a cold badly aired soil, and resulting in poor yellow fruits. Digging and aeration immediately cured the trees.

The inflorescence and flowers of the **banana** have been closley studied and a separate paper on them will be written. The manuring of the banana is being investigated and a model plantation has been started.

In **rice,** many artificial crosses have been made, to study how the plant characters behave in crosses and to get breeding material. A rice classification has now been drawn up.

The study of **wild fodder plants** has resulted in the publication of a first bulletin describing the character and qualities of 34 plants which have been thoroughly tested. The work is being continued. In addition, about two acres of land in the estate of His Excellency the Governor at Ganeshkhind have been put at our disposal for improvement of the grass and an experiment on this is now in progress.

At the request of the Superintending Engineer, Deccan Irrigation Division, an investigation was made of the **aquatic weeds** threatening to block the Godavari and Pravara canals. The main weed is a plant called *Potamogeton perfoliatus.* Its life-history has been described, and measures for its eradication suggested.

The work on **plant diseases** has been carried on vigorously. The smut of sugarcane and red-rot of sugarcane are both under investigation. In the case of sugarcane smut, infection is both through sets and by aerial infection. Steeping sets in copper sulphate solution has proved useless in checking the disease and harmful to the cane. The red-rot disease is greatly exaggerated by water-logged conditions and the importance of drainage is being insisted on. A new and curious disease of betelnut palms—the so-called " Band " disease—is being studied. No fungus or insect appears to cause it. It results in the sterility of the tree. The measures against *koleroga* disease of the same palm are being strenuously pushed. Eighteen garden owners had their plantations treated, as against ten last year, and 9,434 trees were sprayed as against 1,745 last year.

Work on the smuts of jowar has now reached a stage when it can be embodied in a Memoir, and this is under preparation. Various other diseases are under study.

Demonstration of spraying for grape vine mildew was this year done at Junnar and Limbgoa and will be carried on next year at the latter centre.

On the whole the year has been one of progress in all direction. Much knowledge has been gained and imparted, and relations between the department and the public, especially owners of irrigated lands, have become closer and more friendly.

W. BURNS,
Economic Botanist.

APPENDIX J.

ANNUAL REPORT OF THE AGRICULTURAL ENGINEER FOR THE YEAR ENDING 30TH OF JUNE 1916.

INTRODUCTORY.

There has been no change in the superior staff of this Department and I held the post of Agricultural Engineer throughout the year. Work in the main sections of the Department, *i.e.*, Pumping, Boring, and Steam Ploughing, have been gradually developing as hitherto and particulars of every section are given below.

POWER PUMPING.

The efforts of the Department to popularize power pumping have met with a certain amount of success and each year erections are made; the conservative spirit of the ryots in this country however does not allow them to take full advantage of the benefits to be had from power pumping, Consequently the work progresses very slowly; moreover, owing to the war imported machinery has almost become prohibitive in price and many plants that would under normal conditions be erected are held up on account of this crisis.

One effect of this is seen from the number of enquiries received during the year under report. The total number of enquiries this year is 411 against 442 last year, which can be divided as under :—

Northern Division	..	105
Central Division	..	146
Southern Division	..	78
From Outside Bombay Presidency	..	77
Sind	..	5
		411

The pumping enquiries can be divided as under :—

From well	..	80
From river	..	59
		139

Enquiries received from sources other than pumping can be divided as under :—

Cane crushing	..	4
Boring	..	236 (enquiries from Gujarát excluded).
Power ploughs	..	23
Engine driving class	..	9
		272

The following is the list of power plants erected by this Department both for Government and for the cultivators :—

Private.

Pat	.. Combined pumping plant consisting of a 6½ B. H. P. oil engine and a 4″ centrifugal pump.
Viramgam	.. Combined pumping plant consisting of 3 B. H. P. oil engine and a 2″ centrifugal pump.
Hadapsar	.. 15 B. H. P. crude oil engine and a Chatnooga 3-roller sugarcane mill with juice and circulating pump.
Samarkha	.. 20 B. H. P. crude oil engine and a 4″ high lift slow speed centrifugal pump with countershaft.
Supne	..Two 11·4 B. H. P. Clayton valveless crude oil engines and two 3″ Ruston's centrifugal pumps.
Shera	..Chain driven combined pumping plant consisting of a 6′6 B. H. P. crude oil engine and a 3″ centrifugal pump.
Agarkhed	..25 B. H. P. crude oil engine and a 5″ centrifugal pump with a steel tower, down-take pipes and a long line of 9″ stoneware pipe about 800′ in length.

Ránibennur	..Combined pumping plant consisting of a 4 B. H. P. oil engine and a 2½″ centrifugal pump.
Hiraj	..Combined pumping plant consisting of a 4 B. H. P. oil engine and a 2½″ centrifugal pump.

Government.

Dhárwár	..One chaff-cutter.
Surat	..One grinding mill and sifter.
Jalgaon	..One Platt's double roller cotton mill.
Gokák	..Chaff-cutter and extension of shafting.
Workshop	..Three Hand pumps, 1 Hand power double mhote. One Vertical Spindle pump, one Pulsometer pump, one Worthington steam pump.

List of Repairs to Government and Private Plants.

Hiraj	..Overhauling the engine and attending to minor repairs.
Vansol	..Repairs to pump.
Ode	..Repairs to pump.
Kirtane's plant	..Repairing the engine and testing same.
Mutalik	..Renewing the springs on the countershaft discs and putting the engine in order.
Turmuri I	..Setting the valves and overhauling the engine.
Kalas	..Overhauling the engine.
Agarkhed	..Rebuilding the old pulley.
Yatgiri	..Repairing the vapouriser and putting the engine in order.

Government.

Loni School	..Repairs to power plant.
Nangaon Plant	..Renewing the pump plunger pins and main bearings and renewing the gas producer girders.
Dhárwár	..Repairs to drum pump.
Nadiád	..Repairing and overhauling the engine. Renewing pump spindle and bearings, etc.
Surat	..Overhauling and repairing the engine.
Ganeshkhind	..Refixing 6″ pipe line together with minor repairs to the engine.
Gokák	..Renewing the foundation of the engine together with other necessary alterations.

List of Works on Hand.

Government.	Private.
Kopergaon.	Bund Gardens.
Dhulia	Bhambora pipe line.
Nadiád	Tirmuri pipe line.
Dhárwár	Ghaswala.
Workshop Machinery.	
Experimental Well.	
Jalgaon.	

Successful Irrigators.

Amongst successful irrigators I may mention that Mr. Kuber of Dahivádi, Sátára District, is taking full advantage of his power plant and has in two years turned a piece of waste land into a huge garden.

Another gentleman Mr. K. T. Karulkar of Umbergaon has also taken full advantage of the plant and has kept his machinery remarkably well. The plant looks as though erected only yesterday although as a matter of fact it has been working over twelve months.

Experiments.

Experiments with a view to obtain sweet water near the seashore at Kumtha, by means of a convoluted tube well and to use same for irrigation have been made. The sand met with however was too fine (being only ⅛ m.m. in size). Pumping was therefore rendered impossible owing to the choking of the tube. The convoluted tube well was driven 32 feet at a distance

of 300 yards from the sea and water was tapped at 10 feet from surface but the sand almost immediately choked the pipe, and although every measure was taken to overcome the difficulty I eventually abandoned the experiment as a failure. Further tests will be made when a more suitable tube is on the market.

Combined Pumping Plants.

These plants were described in last year's report but since then several changes and tests have been made with the result that I can recommend them for suitable schemes as most satisfactory sets of pumping machinery.

Letters Patent have also been obtained and Messrs. Marshall Sons & Co., of Ballard Road, Bombay, appointed sole makers of the plant in India.

A comparative statement showing area irrigated by one of these plants and 2 mhotes of 4 bullocks each is appended. The statement is based on actual figures obtained by working the plant and mhotes and measuring their delivery by accurate gauges.

WORKSHOPS.

The workshop building is now ready and the machinery is being fixed with all possible speed.

The class for the training of oil engine drivers has also commenced, and the following circular was issued to the Collectors and Deputy Directors of Agriculture throughout the Presidency.

Circular.

The Agricultural Engineer's Workshop building is practically completed and the installation of the machinery is in progress. The object of this workshop is twofold, *viz.*, (1) to modify machinery both for Government and for private owners, (2) and also to train prospective owners and all those interested in Agriculture in the practical handling of power plants.

The time required for this tuition will depend more or less on the student, but three to four months should be sufficient provided attention is given to the work on hand and to the remarks of the instructor.

The course will take the form of a sound practical training and will only deal with the theoretical side so far as is considered absolutely essential.

A certain amount of time each day will be devoted to the students in explaining the functions of the various parts of the oil engine, centrifugal pump, and such other machine as is found necessary during the course. The rest of the day will be devoted to actual shop practice and each student will be expected to assist the Government Engineers on the work in progress. When convenient they will also be taken to existing plant in the district to be shown the method of adjusting the working parts.

This will however only be done as a final test before declaring the student fit to take charge of a power plant.

The shop will be open from 7-30 a.m. until 5-30 p.m. or longer by special arrangement with a recess of 1½ hours.

Each student is expected to attend throughout the working day and take part in the actual work except during the time especially devoted to oral instruction and to the recess.

For the present no fee will be charged for tuition and each student must make his own arrangements for board and lodging.

No student will be detained beyond the time specified provided he is considered competent to take charge of machinery.

The time limit will be altered as experience proves necessary for ordinary cases and in special cases a longer period than is necessary will be arranged provided the student is desirous of becoming more proficient.

No student will be admitted unless he is prepared to devote the whole day and period to the course and bind himself to these rules laid down and approved by the Director of Agriculture. All complaints to be made direct to the Agricultural Engineer.

All applications for admission must be made direct to the Agricultural Engineer and all such applications will be considered in turn and notification will be issued as to when each applicant can commence the course.

For the present not more than 6 students will be admitted at a time but this will be modified if thought necessary.

Applications will be considered from the 1st of June onwards.

It is not essential that the student should know English as the instruction will be given in English, Maráthi, Kánarese and Gujráthi. It will be necessary however to have not less than three students at a time knowing either one or the other of the vernaculars mentioned.

It must be distinctly understood that no guarantee for employment will be given to any student when the course is completed.

The workshop is situated in the Poona Agricultural College compound, about two miles from Poona main Post office on the Ganeshkhind Road.

Below is the list of men trained in oil engine driving and other agricultural machinery during the year under report :—

Engine Driving.

Name.	Place Student came from.	Time taken for tuition.	
		Months.	Days.
1. R. K. Kulkarni ..	Gadag ..	7	24
2. Kolhoro ..	Sind ..	2	0
3. Kedu Satu, Dhulia Farm driver.	Dhulia ..	8	6
4. K. R. Jahagirdar ..	Gujarát ..	2	15
Deshpande Brothers ..	Satára ..	1	15

Handling of the Boring Machine.

1. Abdul Sutar ..	Jodhpur ..	5	9
2. Shesho Krishna ..	Ránebennur ..	2	0
3. S. K. Joglekar ..	Dhulia Local Boad.	3	0
4. Pandharinath ..	Mádha ..	2	0
5. Men from Sunth State ..	Sunth State ..	0	8
6. Vadilal Morarji ..	Sanand Estate ..	1	0
7. Khemchand ..	Kotha State ..	1	15

Cane Crushing.

The Assistant Registrar, Co-operative Societies, induced the Hadapsar Co-operative Society to purchase a cane-crushing plant which consisted of a 3-roller crusher (Chatnooga) and a 15 B. H. P. Blackstone crude oil engine, both purchased and erected by this Department. Total cost of the plant amounted to Rs. 6,365-8-6 and has been designed to crush 50 acres of cane in four months.

Boring Department.

Introductory.

Boring operations have been conducted in the Deccan, Southern Marátha Country, and Gujarát, but as a regular famine appeared to be imminent I set 16 machines working in Kaira and Ahmedabad Collectorates during September and had 23 going in October. This year 215 bores were undertaken in Gujarát and the percentage of success is 83·67. It will be interesting by way of comparison to state here that work done in a similar year of famine, *i. e.*, 1911-12, with 28 sets, one boring overseer and 4 assistants, was only 138 bores, and the percentage of success was only 77. During the year under report 398,200 gallons of water per hour have been tapped.

Thásra Táluka Bores.

A few bores were taken in Thásra Táluka to assist the work of the steam plough, *viz.*, a 6″ bore 90′ deep from the surface near the seventh mile on the Dakore-Kapadwanj road side. Water was struck first at 87′ 7″ and again at 90 feet. A petrol power pumping plant was fixed and water was pumped direct from the bore during the months of April and May for the steam engines. The quantity of water required was 1,600 gallons per day. A Local Board well at Chandasar on the fourth mile was also bored for steam plough. By this means the water problem for steam plough was overcome. It is proposed to use these bores as a source of water for the people passing between Dakore and Kapadwanj. There is now a good demand for boring in Thásra Taluka and a machine will be worked there as long as enquiries are forthcoming.

Effect of War on Boring.

Boring has been affected very considerably by reason of the war especially as regards pipes, and this can be judged from the statement below :—

	Pre-War rates.	Current rates.
(Pipes per foot.)	Rs. a. p.	Rs. a. p.
$2\frac{1}{2}''$ ..	0 10 0	2 2 6
$3''$ ..	0 13 0	2 3 7
$4''$ ..	1 4 0	3 9 6
$6''$ ..	3 12 0	5 10 0
Shoes (per unit).		
$2\frac{1}{2}''$ ..	5 0 0	7 0 0
$3''$ ..	8 0 0	12 0 0
$4''$ ..	11 0 0	18 0 0
$6''$ ..	30 0 0	96 0 0

Expenditure and statement.

The expenditure in Gujarát for boring amounted to Rs. 14,772-11-10 excluding pipes and shoes which cost another Rs. 10,441-15-3. This does not include money invested on purchase of boring machines, tools and plants, etc., which will last for some years. Recoveries during the year excluding last year's recoveries amount to Rs. 8,028-10-11. Recoveries to be made amount to Rs. 8,030-11-6. The expenditure borne by Government for famine boring operations in Gujarát can therefore be roughly taken at Rs. 9,155-4-8. A statement giving full particulars of bores taken in Gujarát and the Deccan is appended.

Men trained in handling Boring Machines.

A few Local Boards, Municipalities and States purchased boring machines during the year under review and sent their men to be trained in the handling of these machines. Smart coolies were also picked up and trained with a view to provide a reserve of mukadams in case of sickness. This system proved satisfactory and resulted in little time being lost for want of mukadams.

Number of Applications registered in Gujarát.

Four-hundred and five applications for boring in Gujarát have been registered which proves that keen interest is being taken by agriculturists in this class of work, but to comply with all the applications received in one season many more boring machines would be necessary. With the limited number of machines at my disposal however I was able to make 215 bores.

Boring in the Deccan and S. M. Country.

Boring operations in the Deccan and Southern Marátha Country were conducted as before, but most of the machines were tansferred to Gujarát to meet the famine conditions.

Peculiar Tracts.

We have conducted boring operations in the vicinity of Deoláli where 11 bores have been made, out of which 9 are successful. These bores are mostly taken from the surface and the boreholes are being provided with suitable pumps. Bores made near Dhulia, Jalgaon, and in Sinkheda Táluka in Khándesh have proved failures, but the District Local Board has made four bores out of which 3 are successful. Bores made near Umbergaon in Thána District are successful and there is one special feature which encourages further bores being taken, *viz.*, that the bores have water flowing into the wells and giving a large quantity of water similar to those in Gujarát. Another interesting bore has been made at Gokák Government Farm in the Belgaum District, where a hole 3″ diameter and 154 feet deep was made with a view to determine the nature of the underlying stratum and the possibilities of boring in an untried tract. The stratum encountered consisted of quartzite, trap stone, sand stone, lime stone, and river washed sand. Water was eventually tapped and rose to within 9′ 2″ from the surface.

Subsequent pumping operations proved the capacity of the bore to be 960 gallons per hour. The pump selected was of greater capacity than the bore hole supply ; consequently the pumping was intermittent and the capacity was the average per hour on the days pumping. The water tapped was sweet and a great improvement on the well water that was previously being used by the farm staff. My original idea was to go at least 200 feet, but as sand was encountered and only having a 3″ bore from the commencement I found it impossible to reduce the size without importing very special tools, and the work was stopped. A casing was driven from the surface through the soil into the underlying rock and a pump fixed just over ground level and the well sealed so that there is absolutely no fear from surface contamination.

Boring in Sind.

This year a new departure has been made and experiments with a Musto machine have commenced in Sind.

Steam Plough.

Two steam ploughing sets have been working under me this year and both are from a commercial and engineering point of view quite successful.

Kaira Steam Plough.

It was expected that this plough would start work in the second or third week of October 1915, but owing to famine conditions the work was postponed until 12th November 1915, when ploughing commenced at Ajupura. Experiments were first made with the disc plough which were not satisfactory ; the tackle was then removed to Kathana and work with the cultivator was commenced ; the land was very hard however and many points were broken daily, but the average daily rate of work rose from $6\frac{3}{4}$ acres to 10 acres. This speaks for itself. A larger cultivator has been received recently and will be tried next season. One more flat is also being added to the present harrow with a view to widen same so that when these two new implements are brought to work the acreage ploughed per day should be on the increase. To avoid recurrence of stoppages for points I have stocked them in large numbers. Cost of points used during the season amounts to Rs. 1,300. As haulage has been a source of continuous trouble both at Ránebennur and Dákore and as local men could not be found to take up this work properly I induced a contractor from Poona to take it up and supply coal at both the places. This man made satisfactory arrangements for haulage and supplied good coal. The charges under this head however appear high but when the stoppages for want of coal and water are taken into consideration it will be seen that there is a saving over previous years. This year the heat was excessive in Ajupura, Kathana, etc., and the drivers and ploughmen suffered in consequence. It is creditable however that in spite of this trouble and scanty accommodation they worked well throughout the season.

Statement of Working.

Number of working days	..	$157\frac{1}{4}$
Stoppages due to rains	..	$3\frac{1}{2}$
Washing out days	..	24
Breakages	..	6
Shifting	..	$10\frac{1}{4}$
Want of points	..	5
Holidays	..	2
		208

Out of 208 days $50\frac{3}{4}$ were unavoidably lost and only $157\frac{1}{4}$ days fully utilized. If 180 days can be worked in a season results will be much more satisfactory.

Particulars of Work done and Charges realized.

Kind of operation.	Area.		Rate charged per acre.			Amount.		
	Acres.	Gunthás.						
Single operation ..	162	16	11	0	0	1,786	6	4
Combined operation ..	41	38	14	0	0	573	4	9
Double operation ..	998	29	16	0	0	16,283	4	10
Harrow after combined operation ..	42	22	20	0	0	851	0	0
						19,493	15	11

I am glad to say that in the absence of a European ploughman both the tackles increased the average daily rate of work, which proves that a large steam cultivating tackle can be run by an Indian ploughman. Of course a reasonable amount of supervision and good administration are quite necessary for such projects.

Balance Sheet of the Kaira Steam Plough for Season ending 30th June 1916.

Dr.					*Cr.*			
	Rs.	a.	p.		Rs.	a.	p.
Establishment ..	4,212	6	10	Ploughing charges ..	19,493	15	11
Miscellaneous Charges ..	304	6	0	Coal on hand ..	1,300	0	0
Labour ..	417	8	0	Stores on hand (including last year's stores on hand as well).	3,996	10	6
Fuel ..	5,948	5	7				
Haulage ..	3,060	11	6				
Stores ..	4,247	13	1				
Repairs ..	1,528	4	0				
Tools and Plants ..	985	6	1				
Interest at 6¼% ..	2,656	0	0				
Depreciation ..	1,220	0	0				
Balance by profit ..	209	13	4				
Rs. ..	24,790	10	5	Rs. ..	24,790	10	5

The above balance sheet will show that the Kaira steam plough has been a commercial success this season. During the last two seasons this tackle has brought 2,072 acres 33 gunthas of forest land under cultivation.

Ranebennur Steam Plough.

This season has been so short that we only got 150 total days (130 for deep and 20 for shallow ploughing), which gave 105 actual working days. In this time 554 acres 5 gunthas of deep and 146 acres and 7 gunthas shallow (total 700 acres and 12 gunthas) were ploughed and Rs. 15,607-3-7 realised. As an experiment having the extension of season in view a shallow plough with four furrows was brought from Dákore and worked after the deep ploughing was over. For the first two or three days we made an average of 8 acres, then rain commenced, and finally I stopped the work. In order to pass final opinion on shallow ploughing at Ránebennur further tests will be made next season.

Haulage.

Haulage proved much more satisfactory than either of the previous two seasons, and time lost for fuel and water was practically negligible.

Balance Sheet of the Ránebennur Steam Plough for season ending 30th June 1916.

Dr.					*Cr.*			
	Rs.	a.	p.		Rs.	a.	p.
Casual Labour ..	26	14	0	Ploughing charges ..	15,607	3	7
Haulage ..	2,664	0	0	Miscellaneous Receipts ..	5	5	6
Fuel ..	7,124	12	4	Coal on hand ..	2,000	0	0
Establishment ..	3,842	7	3	Stores on hand* ..	5,162	10	0
Depreication ..	1,168	0	0	Dead Stock ..	150	14	0
Repairs ..	29	3	0				
Miscellaneous charges ..	683	6	8				
Stores ..	4,128	0	0				
Interest at 6% ..	2,430	0	0				
Last year's stores used ..	657	5	0				
Balance by profit ..	172	0	10				
Rs. ..	22,926	1	1	Rs. ..	22,926	1	1

* *N.B.*—On examination of material and parts used in previous seasons it was seen that some parts could be reused by repairs and material used in making new parts. Current value of such material and parts, *i. e* Rs. 910-11-6 for reuse, is taken into consideration and included in valuation of stores on hand.

Below is the statement showing days lost during the season :—

	Days.	Hours.	Mts.
1 Shifting ..	16	8	15
2 Accidents ..	5	11	40
3 Holidays ..	·3	0	0
4 Washing out ..	14	0	0
5 Rain ..	4	8	0
Total days lost ..	44	3	55

The daily average rate of work for the last three seasons for deep ploughing is as follows :—

1913-14	..	.. 5·769
1914-15	..	.. 5· ·
1915-16	..	.. 6·6

The Director of Agriculture, taking the abnormally short season and consequent difficulties to make the project a commercial success into consideration, has consented to extend deep ploughing season from 1st of November to 1st of May provided land is obtainable. The rate for land ploughed before 15th of December and after 15th of April will be Rs. 21 per acre, This concession will, it is hoped, be a means to secure land to extend the season and the work of the Rânebennur steam plough will then be comparatively easy as a commercial project.

Staff at Ranibennur.

The staff at Rânibennur did well during the year, and Messrs. Talegaonkar and Modak deserve special mention for their good work .

General Remarks.

Blasting experiments were made which showed that unless a suitable firing instrument is available torpedoing is not possible. I am awaiting such an instrument and will continue the experiments when it is to hand.

With the help of Dr. Mann several water samples from bore holes, wells and rivers were analysed and owners informed of the results. This served as a guide to them in determining use of water available.

This year Government sanctioned increase in my establishment as under :—

Four fitters, two carpenters, 3 masons, and one moulder.

One fitter and 1 non-graduate fieldman for steam plough.

The men in all sections of work under me are fully engaged on account of the increasing activities of the Department.

The clerical work in my office has so increased that no less than 17,365 letters were handled this year against 9,581 letters last year.

The total of the Budget grants stood at Rs. 1,32,655 for the financial year 1915-16.

The total receipts from all sources amounted to Rs. 9,314-5-4, full account of which is kept in my office.

In addition to the above there are 21 private acounts under my official designation running with the Bank of Bombay and the total of payments made on such accounts amounts to Rs. 47,930-8-7 and the total sum received on these accounts amounts to Rs. 80,293-7-4. The grand total amount handled by this office is Rs. 2,70,194-5-3.

I have only four clerks in my office and feel this staff quite inadequate for the work on hand. Proposals for revision of same will be submitted in due course.

I wrote a note on well boring and circulated it as a departmental bulletin. One or two articles were also written on pumping and published in the Shetki and Shetkari Magazine.

My staff has done good work during the year under report.

The year under review has been on the whole a year of progress in spite of the disturbed situation created by the war.

W. M. SCHUTTE,

Agricultural Engineer, Bombay Presidency, Poona.

A Comparative Statement showing Area irrigated by a combined Pumping Plant and two Mhotes of four Bullocks each.

Crops—Lucerne and Cane.

The pump irrigates $5\frac{4}{5}$ gunthas per hour, hence it will irrigate one acre in 6·9 hours (or 6 hours and 54 seconds).

Two mhotes each worked by 4 bullocks irrgate $4\frac{1}{2}$ gunthas in one hour, hence they will irrigate one acre in 8·8 hours.

The fuel consumption of the engine in 6·9 hours is 20·7 pints, which will cost Rs. 1-9-$10\frac{1}{2}$ at $1\frac{1}{4}$ anna per pint.

Cost of lubricating oil 1 pint at Rs. 2-8-0 a gallon = 5 as.

Driver's wages at Rs. 10 per month for one day=5 annas and 4 pies.

	Rs.	a.	p.
	1	9	$10\frac{1}{2}$
	0	5	0
	0	5	4
Total expense to irrigate one acre by the combined pumping plant ..	2	4	$2\frac{1}{2}$

Now to irrigate an acre by two mhotes each of 4 bullocks in 8·8 hours or for a full day we shall require 4 pairs of bullocks with 2 servants.

	Rs.	a.	p.
The hire charges for 4 pairs at Re. 1 a pair are (excluding a driver) ..	4	0	0
Charges of two servants at As. 6 a day are ..	0	12	0
Total charges to irrigate one acre of cane by mhotes ..	4	12	0
against			
The charges required by the Pumping Plant ..	2	4	2½
Difference per acre ..	2	7	9½

Note.—The pumping plant in this case had been worked for only 6·9 hours, which is much less than the usual working hours of power plants. If this plant is worked for 10 hours we shall get the total area irrigated equal to about 1½ acres. Whereas the mhotes being already worked for 8·8 hours, which is more than a day's work to the bullocks, cannot possibly be worked for a longer time. If we therefore take one day's full work for the plant as well as for the bullocks we shall find that the plant will do 1½ acres for Rs. 3-6-3¾ and the mhotes only one acre for Rs. 4-12-0.

Now, in order to irrigate the same area of 1½ acres by the mhotes we shall have to spend Rs. 7-2-0, which will be found in excess by Rs. 3-11-8¼ (Rs. 7-2-0—Rs. 3-6-3¾) when irrigating by the pump every day. Taking into consideration 240 days as the working days throughout the year we shall effect a gain by working the pump of Rs. 895-5-0 (240 × 3-11-8¼) at the end of the year.

As the bullocks are to be hired we shall not have to pay for the initial outlay, interest, depreciation, etc., whereas in case of a power pump these will have to be allowed for :—

(Assuming cost of the plant Rs. 1,400 complete).		Rs.
Interest at Rs. 6 per cent. per annum on Rs 1,400 ..	=	84
Sinking fund at 5 per cent. for depreciation at 10 per cent. × 2/3 (240/360) on Rs. 1,400.	=	71
Repairs at 5 per cent. × 2/3 ..	=	47
Drivers' wages, lubricating oil and waste, etc., are alaredy taken into consideration ..		202

These subtracted from the difference of Rs. 895-5-0 we shall get a net profit of Rs. 693-5-0 per year by working the power plant instead of the mhote. It should however be noted that repairs on mhotes are neglected.

W. M. SCHUTTE,
Agricultural Engineer, Bombay Presidency, Poona.

Detailed statement of bores taken during the year 1915-16.

Serial Number.	Name of well owner.	Taluka.	Village.	Diameter of bore.	Depth of boring.	Water before boring per hour in gallons.	Water after boring per hour in gallons.	Departmental charge.	Labour charge.	Total cost of bore hole.	Cost per foot.	Result and Remarks.
	GUJARAT. *Kaira District.*			Inches.	Ft. In.			Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	
1	Marghabhai Gopalbhai	Nadiad	Saloon	3	75 0	1,000	6,000	84 7 0	22 8 0	106 15 0	1 6 9	Successful.
2	Kishorbhai Jijibhai	Do.	Do.	3	90 0	1,000	6,000	95 2 5	37 2 0	132 4 5	1 7 6	Do.
3	Haribhai Jibhai	Do.	Do.	3	83 0	500	1,000	91 1 5	24 9 0	115 10 5	1 6 3	Do.
4	Sanitary Board Well	Anand	Sarsa	2½	104 0	1,000	4,000	153 15 1	200 0 0	353 15 1	3 6 5	Do.
5	Kishorbhai Jijibhai	Nadiad	Saloon	3	45 0	1,000	5,000	56 1 10	14 6 0	70 7 10	1 9 0	Do.
6	Naranbhai Lalloobhai	Borsad	Vadadla	2½	114 6	500	1,000	109 1 3	102 4 0	211 5 3	1 11 1	Do.
7	Haribhai Shankarbhai	Nadiad	Mahmadpara	2½	100 0	500	2,000	95 1 1	139 12 0	234 13 1	2 5 6	Do.
8	Monorbhai Jijibhai	Matar	Radwanj	2½	43 0	500	1,000	38 12 1	15 0 0	53 12 1	1 4 0	Do.
9	Bhaiji Nagardas	Nadiad	Saloon	3	185 0	1,000	2,000	209 11 10	91 11 0	301 6 10	1 10 0	Do
10	Samal Kishabhai	Matar	Radwanj	2½	29 0	500	1,500	39 8 8	13 6 0	52 14 8	1 13 2	Do.
11	Someshwar Naran	Do.	Sandhana	2½	20 0	250	1,000	31 1 5	16 0 0	47 1 5	2 5 8	Do.
12	Samal Kishabhai	Do.	Radwanj	2½	30 0	500	1,000	39 1 5	14 2 0	53 3 5	1 12 4	Do.
13	Talsibhai Kashibhai	Do.	Sokhada	2½	55 0	250	1,000	63 15 1	21 12 0	85 11 1	1 8 11	Do.
14	Moti Raiji	Do.	Radwanj	2½	50 0	250	1,000	61 5 0	38 8 0	99 13 0	1 15 11	Do.
15	Gopaldas Viharidas	Nadiad	Utarsanda	3	23 0	500	1,000	45 0 6	17 1 6	62 2 0	2 11 2	Do.
16	Do.	Do.	Do.	3	94 0	1,000	2,000	121 7 1	34 5 0	155 12 1	1 10 6	Do.
17	Someshwar Harilal	Matar	Sokhada	2½	100 0	1,000	3,000	117 8 9	55 4 0	167 12 9	1 8 2	Do.
18	Jedhabhai Muljibhai	Anand	Anand	6	...	...	...	.....	.....	.....	...	Incomplete.
19	Doolabhai Bhulabhai	Matar	Radwanj	2½	60 0	...	...	.....	.....	.....	....	Unsuccessful.
20	Samalbhai Lalloobhai	Mehmdabad	Akalacha	2½	41 0	250	1,000	44 2 6	29 0 0	73 2 6	1 12 4	Successful.
21	Harilal Chunilal	Nadiad	Mahudha	2½	...	...	...	.....	.....	.....	...	Incomplete.
22	Samalbhai Lalloobhai	Mehmdaba d.	Akalacha	2½	50 0	1,000	2,000	48 11 9	21 15 0	70 10 9	1 6 7	Successful.
23	Khodabhai Bhagwandas	Nadiad	Keriavi	2½	188 0	1,000	2,000	211 0 8	225 0 0	436 0 8	2 3 4	Do.
24	Jibabhai Jijibhai	Anand	Boriavi	2½	62 0	250	1,000	73 5 4	37 2 0	110 7 4	1 9 11	Do.
25	Ravjibhai Chhotabhai	Mehmdabad	Vathavali	2½	22 6	1,000	2,000	33 2 5	28 2 0	61 4 5	2 11 6	Do.
26	Moti Mulji	Do.	Sunj	2½	21 0	250	1,000	31 7 10	14 0 0	65 7 10	2 4 2	Do.
27	Abhaji Joosaji	Do.	Kachhai	2½	56 0	1,000	6,000	116 8 10	23 10 0	140 2 10	2 8 0	Do.
28	Fakirbhai Haribhai	Nadiad	Mitral	2½	18 0	500	1,000	33 6 7	22 0 0	55 6 7	3 1 3	Do.
29	Haribhai Shankarbhai	Do.	Utarsanda	3	117 0	1,000	6,000	21 8 5	37 2 0	158 10 5	1 5 8	Do.
30	Lalloobhai Jivabhai	Nadiad	Mahudha	2½	18 0	1,000	2,000	32 12 6	13 2 0	45 14 6	2 8 9	Do.
31	Motiram Mulji	Mehmdabad	Sunj	2½	23 6	1,000	2,000	34 15 10	10 10 0	45 9 10	1 15 0	Do.
32	Bhailal Dabhai	Matar	Sandhana	2½	27 0	1,000	3,000	44 13 0	22 0 0	66 13 0	2 7 7	Do.
33	Ashabhai Dungardas	Mehmdabad	Rinchol	2½	52 0	1,000	2,000	75 3 8	27 8 0	102 11 8	1 15 7	Do.
34	Lalloobhai Lalaji	Anand	Vansol	3	36 0	2,000	4,000	59 3 6	16 10 0	75 13 6	2 1 8	Do.
35	Do. Shankarbhai	Mehmdabad	Akalacha	2½	95 0	500	1,000	70 10 7	28 0 0	98 10 7	1 0 7	Do.
36	Gabahbai Galubhai	Nadiad	Mahudha	2½	40 0	500	4,000	72 12 6	26 12 0	99 8 6	2 7 9	Do.
37	Babar Natha	Mehmdabad	Sunj	2½	28 0	500	1,000	46 11 10	17 11 0	64 6 10	2 4 9	Do.
38	Chatur Vaghaji	Nadiad	Mitral	2½	31 0	...	...	.....	.....	.....	...	Unsuccessful.
39	Mulji Bechar	Matar	Sokhada	2½	130 0	...	...	.....	.....	.....	...	Do.
40	Bhula Jesha	Nadiad	Chaklashi	2½	58 0	...	...	.....	.....	.....	...	Do.
41	Mangalbhai Bhababhai	Do.	Kanjoda	2½	71 6	1,000	5,000	112 4 8	59 10 0	171 14 8	2 6 5	Successful.
42	Nathabhai Hathibhai	Matar	Vansar	2½	44 0	500	1,000	68 4 10	27 8 0	95 12 10	2 2 10	Do.
43	Lalloobhai Lalaji	Anand	Vansol	3	103 0	...	...	.....	.....	.....	...	Unsuccessful.
44	Sana Kuber	Do.	Vadod	2½	56 0	1,000	6,000	107 8 6	96 14 0	204 6 6	3 1 4	Successful.
45	Soma Bala	Mehmdabad	Kachai	2½	32 6	1,000	6,000	56 11 8	13 0 0	69 11 8	2 2 3	Do.
46	Lalbhai Kamabhai	Nadiad	Mahudha	2½	40 8	1,000	5,000	63 10 0	25 2 0	88 12 0	2 2 11	Do.
47	Chababhai Nathabhai	Do.	Do.	2½	40 0	1,000	4,000	60 12 1	23 8 0	84 4 1	2 1 8	Do.
48	Meru Hema	Mehmdabad	Kachhai	2½	68 0	500	1,000	89 15 1	104 6 0	194 5 1	2 15 2	Do.
49	Zeborbhai Varajbhai	Anand	Sadanpara	2½	66 0	500	1,000	87 8 2	55 0 0	142 8 2	2 2 6	Do.
50	Trabakbhai Dabhai	Matar	Vansar	2½	45 6	1,000	4,000	57 14 5	27 2 0	85 0 5	1 13 10	Do.
51	Kana Ranchod	Mehmdabad	Sunj	2½	30 0	1,000	3,000	44 13 3	20 9 0	65 6 3	2 2 10	Do.
52	Umedbhai Vaghajibhai	Nadiad	Kanjoda	2½	117 0	1,000	2,000	136 4 5	71 12 0	208 0 5	1 12 5	Do.
53	Gokalbhai Shankarbhai	Do.	Davda	2½	72 0	1,000	3,000	70 12 0	27 8 0	98 4 0	1 5 10	Do.
54	Keshavlal Ishwardas	Mehmdabad	Sunj	2½	27 0	500	1,000	39 5 6	15 4 0	54 9 6	2 5 7	Do.

Serial Number.	Name of well owner.	Taluka.	Village.	Diameter of bore.	Depth of boring.	Water before boring per hour in gallons.	Water after boring per hour in gallons.	Departmental charge.	Labour charge.	Total cost of bore hole.	Cost per foot.	Result and Remarks.
	Kaira District—contd.			Inches.	Ft. In.			Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	
55	Hamid Hamu ...	Mehmdabad .	Chhapra ...	2½	28 0	500	1,000	42 1 3	10 0 0	52 1 3	1 10 10	Successful.
56	Nathabhai Becharbhai...	Nadiad ...	Davda ...	2½	71 0	1,000	2,000	61 9 1	29 4 0	90 13 1	1 4 5	Do.
57	Kashibhai Kasalbhai ...	Matar ...	Undhela ...	2½	45 0	500	1,000	58 5 4	19 8 0	77 13 4	1 11 8	Do.
58	Shankar Raiji ...	Anand ...	Vadod ...	2½	43 0	1,000	5,000	54 2 4	11 0 0	65 2 4	1 8 2	Do.
59	Keshawlal Ishwardas ...	Mehmdabad .	Sunj ...	2½	32 0	1,000	2,000	46 9 10	26 5 0	72 14 10	2 4 5	Do.
60	Hamid Hamu ...	Do. ...	Chhapra ...	2½	32 0	1,000	2,000	38 14 5	16 12 0	55 10 5	1 11 9	Do.
61	Ranchod Mansookhram .	Mehmdabad .	Kachhai ...	2½	28 0	500	1,000	40 8 9	20 13 0	61 5 9	2 3 0	Do.
62	Sana Zoozar ...	Do. ...	Rinchol ...	2½	65 0	250	1,000	109 15 7	90 0 0	199 15 7	3 1 2	Do.
63	Local Board Well ...	Thasra ...	Vidhalpura ...	4	153 0	...	...	.....	.....	.....	...	Unsuccessful.
64	Lalloobhai Shankarbhai	Mehmdabad .	Akalacha ...	2½	105 0	...	...	.....	.....	.....	...	Do.
65	Margha Khooshal ...	Do. ...	Do. ...	2½	97 0	500	1,000	92 14 10	52 4 0	145 2 10	1 7 11	Successful.
66	Kashibhai Kashalbhai ...	Matar ...	Undhela ...	2½	68 0	...	...	.....	.....	.....	...	Unsuccessful.
67	Babar Bhaiji ...	Nadiad ...	Mehmdabad Moovada.	2½	84 6	500	1,000	119 10 4	125 0 0	244 10 4	2 12 6	Successful.
68	Dayabhai Miratram ...	Anand ...	Gamdi ...	2½	78 0	...	...	.....	.....	.....	...	Unsuccessful.
69	Moti Shankar ...	Do. ...	Vadod ...	2½	52 0	1,000	4,000	75 12 3	22 0 0	97 12 3	1 14 1	Successful.
70	Babar Ranchod ...	Mehmdabad .	Chhapra ...	2½	116 0	...	...	.....	.....	.....	...	Unsuccessful.
71	Dhanjibhai Mathurbhai.	Nadiad ...	Davda ...	2½	72 0	500	1,000	94 4 3	51 2 0	145 6 3	2 0 3	Successful.
72	Bhulabhai Becharbhai...	Mehmdabad .	Sunj ...	2½	32 0	1,000	2,000	48 10 6	19 12 0	68 6 6	2 2 2	Do.
73	Bhikhabhai Becharbhai.	Do. ...	Akalacha ...	2½	90 0	1,000	4,000	92 14 9	33 0 0	125 14 9	1 6 4	Do
74	Zaver Jijibhai ...	Do. ...	Rinchol ...	2½	109 0	...	...	.....	.....	.....	...	Unsuccessful
75	Harman Talsi ...	Nadiad ...	Soorasmal ...	2½	68 0	1,000	5,000	88 9 9	37 10 0	126 3 9	1 13 8	Successful.
76	Dadoobhai Parsotam ...	Thasra ...	Ajupura ...	6	90 7	...	1,000	744 3 8	149 9 6	893 13 2	9 13 10	Do.
77	Galab Natha ...	Mehmdabad .	Kachhai ...	2½	40 0	500	1,000	58 6 11	29 14 0	88 4 11	2 3 3	Do.
78	Hathibhai Lalloobhai ...	Nadiad ...	Davda ...	2½	80 0	1,000	4,000	84 10 6	29 8 0	104 2 6	1 4 9	Do.
79	Bai Foona ...	Mehmdabad .	Sunj ...	2½	28 0	1,000	2,000	37 8 2	12 0 0	49 8 2	1 12 3	Do.
80	Kabhai Gokalbhai ...	Anand ...	Vadod ...	2½	50 0	1,000	2,000	69 7 2	13 8 0	82 15 2	1 10 6	Do.
81	Saiadmia Ahamadmia ...	Matar ...	Uddhela ...	2½	36 0	1,000	2,000	51 9 2	13 10 0	65 3 2	1 12 11	Do.
82	Chootha Nagaji ...	Nadiad ...	Soorasmal ...	2½	84 0	...	...	.....	.....	.....	...	Unsuccessful.
83	Bhula Koopaji ...	Mehmdabad .	Chhapra ...	2½	37 0	500	1,500	49 7 1	19 4 0	68 11 1	1 13 8	Successful.
84	Margha Khoosal ...	Do. ...	Akalacha ...	2½	127 8	1,000	4,000	204 15 5	55 0 0	60 6 5	2 1 0	Do.
85	Jobhai Chhagan ...	Do. ...	Sunj ...	2½	41 0	500	1,000	71 15 9	26 6 0	98 5 9	2 6 4	Do.
86	Ghelaji Joogaji ...	Do. ...	Chhapra ...	2½	36 0	500	1,000	51 9 2	7 0 0	58 9 2	1 10 1	Do.
87	Motiram Salingram ...	Nadiad ...	Saloon ...	3	31 0	250	1,000	47 8 4	25 4 0	72 12 4	2 5 6	Do.
88	Harilal Chunilal ...	Do. ...	Bhumas ...	2½	30 0	500	1,000	62 5 10	41 8 0	103 13 10	3 7 4	Do.
89	Dhaneshwar Revaram ...	Matar ...	Matar ...	2½	28 0	...	...	.. ...	.....	.....	...	Unsuccessful.
90	Banaji Dhanaji ...	Mehmdabad	Chhapra ...	2½	24 0	500	1,000	41 10 9	6 0 0	47 10 9	1 15 9	Successful.
91	Chaturbhai Hathibhai...	Nadiad ...	Saloon ...	3	30 0	1,000	6,000	44 14 3	20 0 0	64 14 3	1 12 10	Do.
92	Lakhaji Jijaji ...	Mehmdabad .	Chhapra ...	2½	35 0	500	1,000	77 1 0	8 0 0	85 1 0	2 6 1	Do.
93	Parsotam Hathibhai ...	Matar ...	Radhwanj ...	2½	51 0	1,000	4,000	93 4 10	23 12 0	117 0 10	2 4 8	Do.
94	Galab Natha ...	Mehmdabad .	Kachhai ...	2½	58 0	1,000	3,000	88 7 10	55 0 0	143 7 10	2 12 0	Do.
95	Bechar Kanbhai ...	Anand ...	Vadod ...	2½	40 0	500	1,500	104 8 10	13 12 0	118 4 10	2 15 3	Do.
96	Marghabhai Dhoribhai .	Nadiad ...	Davda ...	2½	94 0	500	2,000	156 1 7	54 12 0	210 13 7	2 3 10	Do.
97	Nathubhai Anichaldas...	Do. ...	Saloon ...	3	86 0	1,000	6,000	141 5 10	33 12 0	175 1 10	2 0 6	Do.
98	Bhoghaji Jeshaji ...	Mehmdabad .	Chhapra ...	2½	42 0	...	...	.....	.....	.....	...	Unsuccessful.
99	Shankar Jeshanj ...	Anand ...	Ravlapura ...	2½	108 0	250	1,000	220 2 10	38 8 0	258 10 10	2 6 3	Successful.
100	Ghelabhai Mathurbhai .	Nadiad ...	Chaklasi ...	2½	61 0	...	...	.....	.....	.....	...	Unsuccessful.
101	Nathabhai Anichaldas ...	Do. ...	Saloon ...	3	90 0	1,000	6,000	163 1 1	42 14 0	205 15 8	2 4 7	Successful.
102	Shivabhai Nathabhai ...	Do. ...	Davda ...	2½	70 0	500	1,000	161 0 10	50 0 0	211 0 10	3 2 0	Do.
103	Dhula Jalam ...	Mehmdabad .	Rinchol ...	2½	82 0	...	...	.....	.....	.....	...	Unsuccessful.
104	Government Bore ...	Thasra ...	Chandasar ...	4	90 0	125	1,000	64 13 7	230 1 7	294 15 2	3 4 5	Successful.
105	Shankar Madhav ...	Mehmdabad .	Kachhai ...	2½	51 0	1,000	2,000	120 2 0	27 8 0	147 10 0	2 14 3	Do.
106	Government Bore ...	Thasra ...	Vidhalpura ...	6	...	...	...	.....	.....	.....	...	Incomplete.
107	Sanabhai Venidas ...	Mehmdabad .	Akalacha ...	2½	76 0	1,000	8,000	51 15 4	53 12 0	105 11 4	1 6 2	Successful.
108	Somabhai Kuber ...	Do. ...	Nenpur ...	2½	58 0	...	...	.....	.....	.....	...	Unsuccessful.
109	Shakarbhai Desaibhai...	Nadiad ...	Mahudha ...	2½	21 0	...	...	.....	.....	.....	...	Do.
110	Do. Jeshangbhai.	Anand ...	Ravlapura ...	3	72 0	500	1,000	186 5 10	35 12 0	222 1 10	3 1 4	Successful.

Serial Number.	Name of well owner.	Taluka.	Village.	Diameter of bore.	Depth of boring.	Water before boring per hour in gallons.	Water after boring per hour in gallons.	Departmental charge.	Labour charge.	Total cost of bore hole.	Cost per foot.	Result and Remarks.
	Kaira District—contd.			Inches.	Ft. In.			Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	
111	Ratangar Damodardas ...	Matar ...	Golpara ...	4	108 0	1,000	2,000	201 8 8	154 0 0	355 8 8	3 4 8	Successful.
112	Jiva Dola ...	Anand ...	Gopalpura ...	2½	43 0	1,000	6,000	112 6 1	24 12 0	137 2 1	3 2 3	Do.
113	Parbhdas Kalidas ...	Mehmdabad .	Kachhai ...	2½	78 0	1,500	4,000	187 9 11	70 10 0	253 3 11	3 3 11	Do.
114	Talsi Ranchhod ...	Do. ...	Mokwapura ...	2½	58 0	500	1,000	157 10 7	18 8 0	170 2 7	2 14 11	Do.
115	Nathabhai Becharbhai...	Nadiad ...	Davda ...	2½	49 0	1,000	4,000	113 9 7	15 14 0	129 7 7	2 10 3	Do.
116	Do. Anichaldas ...	Do. ...	Saloon ...	3	53 0	1,000	3,000	101 13 6	35 0 0	136 13 6	2 9 3	Do.
117	Vaghaji Girdhar ...	Mehmdabad .	Akalacha ...	2½	86 0	1,000	3,000	167 7 1	49 8 0	216 15 1	2 11 5	Do.
118	Dhonbhai Kisabhai ...	Anand ...	Navli ...	2½	47 0	1,000	6,000	121 1 3	27 0 0	148 1 3	3 2 5	Do.
119	Margha Khooshal ...	Mehmdabad .	Akalacha ...	2½	126 0	...	...	.....	.....	.....	...	Unsuccessful.
120	Naran Mathurbhai ...	Nadiad ...	Mahudha ...	2½	48 0	...	...	.....	.....	.....	...	Do.
121	Bhikha Bhula ...	Mehmdabad .	Mokwa ...	2½	47 0	1,000	2,000	120 15 10	22 12 0	143 11 10	3 0 11	Successful.
122	Mathurbhai Muljibhai...	Nadiad ...	Utarsand ...	3	70 0	1,000	5,000	108 9 2	21 0 0	129 9 2	1 13 7	Do.
123	Ghelabhai Mathurbhai .	Nadiad ...	Chaklasi ...	2½	26 0	500	2,000	74 10 6	11 0 0	85 10 6	3 4 8	Successful.
124	Babar Hathi ...	Mehmdabad .	Rinchol ...	2½	30 0	500	1,000	81 8 9	27 0 0	108 8 9	3 9 10	Do.
125	Local Board Well ...	Do. ...	Jalampura ...	2½	36 0	250	1,000	98 12 3	48 14 0	147 10 3	4 1 8	Do.
126	Haribhai Babarbhai ...	Thasra ...	Chatur-sumba.	4	90 0	...	1,000	67 4 10	130 0 0	197 4 10	2 3 1	Do.
127	Jivabhai Ranchod ...	Nadiad ...	Gutal ...	3	140 0	1,000	4,000	344 3 1	85 12 6	429 15 7	3 1 2	Do.
128	Some Gaga ...	Mehmdabad .	Kachhai ...	2½	79 0	1,000	3,500	200 1 4	71 11 0	271 12 4	3 7 4	Do.
129	Bhika Bechar ...	Do. ...	Akalacha ...	2½	88 0	...	...	.....	.....	.....	...	Unsuccessful.
130	Natha Becharbhai ...	Nadiad ...	Davda ...	2½	21 0	...	...	.....	.....	.....	...	Do.
131	Babar Hathi ...	Mehmdabad .	Rinchol ...	2½	64 0	1,000	2,000	110 5 8	41 4 0	151 9 8	2 5 10	Successful.
132	Zaverbhai Varajbhai ...	Anand ...	Samarkha ...	2½	81 0	500	1,000	197 3 8	45 4 0	242 7 8	2 15 10	Do.
133	Chhotalal Maganlal ...	Nadiad ...	Mahudha ...	2½	...	...	...	.....	.....	.....	...	Incomplete.
134	Local Board Well ...	Mehmdabad .	Vamali ...	2½	29 0	125	250	78 12 4	68 3 0	146 15 4	5 1 1	Successful.
135	Garbad Bapuji ...	Nadiad ...	Valetwa ...	2½	65 0	...	...	.....	.....	.....	...	Unsuccessful.
136	Tribhuwan Bechar ...	Borsad ...	Napa ...	2½	150 0	1,000	3,000	341 11 6	126 8 0	468 3 6	3 1 11	Successful.
137	Bechar Valabh ...	Mehmdabad .	Rinchol ...	2½	50 0	...	...	.....	.....	.....	...	Unsuccessful
138	Jivabhai Dwarkadas ...	Do. ...	Varsola ...	2½	36 0	...	...	.....	.....	.....	...	Do.
139	Zaverbhai Varajbhai ...	Anand ...	Samarkha ...	2½	27 0	500	1,000	70 13 11	10 0 0	80 13 11	2 15 11	Successful.
140	Shandas Mangladas ...	Do. ...	Thamna ...	2½	66 0	500	1,000	165 9 3	36 0 0	201 9 8	3 0 10	Do.
141	Shankarbhai Lalloobhai	Do. ...	Samarkha ...	2½	35 0	1,000	4,000	93 2 11	25 2 0	118 4 11	3 6 1	Do.
142	Motibhai Bhagabhai ...	Do. ...	Do. ...	2½	50 0	1,000	2,000	127 0 8	14 0 0	141 0 8	2 13 1	Do.
143	Desaibhai Nagarbhai ...	Matar ...	Sandhana ...	2½	...	...	...	.....	.....	.....	...	Incomplete
144	Gordhanbhai Jethabhai.	Borsad ...	Napa ...	2½	...	...	...	.....	.....	.....	...	Do.
145	Temple Well ...	Thasra ...	Dakore ...	4	...	...	...	.....	.....	.....	...	Do.
146	Bechar Valabh ...	Mehmdabad .	Rinchol ...	2½	90 0	500	1,000	197 11 3	95 0 0	272 11 3	3 0 5	Successful.
147	Revandas Bechar ...	Anand ...	Samarkha ...	2½	30 0	1,000	8,000	80 8 7	26 4 0	106 12 7	3 8 10	Do.
148	Khada Baji ...	Do. ...	Do. ...	2½	52 0	1,000	4,000	130 12 10	22 8 0	153 4 10	2 15 2	Do.
149	Shiva Bhula ...	Mehmdabad .	Kachhai ...	2½	...	...	...	.....	.....	.....	...	Incomplete.
150	Narsi Mathurbhai ...	Do. ...	Sunj ...	3	17 6	1,000	2,000	56 10 4	24 12 0	71 6 4	4 1 3	Successful.
151	Motibhai Ranchod ...	Nadiad ...	Bhumal ...	3	91 0	1,000	8,000	237 6 2	60 8 0	297 14 2	3 4 5	Do.
152	Indian Dairy Company .	Do. ...	Nadiad ...	3	80 0	500	2,000	221 11 9	105 0 0	326 11 9	4 1 4	Do.
153	Jiva Bhaiji ...	Anad ...	Samarkha ...	2½	40 0	1,000	5,000	104 0 8	19 0 0	123 0 8	3 1 3	Do.
154	Dalal Gala ...	Anand ...	Samarkha ...	2½	68 0	1,000	5,000	164 10 9	28 2 0	192 12 9	2 14 10	Successful.
155	Lalloobhai Shankarbhai	Mehmdabad .	Akalacha ...	2½	...	...	...	.....	.....	.....	...	Incomplete.
156	Bapuji Mundas ...	Anand ...	Samarkha ...	2½	26 0	1,000	4,000	76 10 4	33 0 0	109 10 4	4 3 5	Successful.
157	Soma Khoda ...	Nadiad ...	Bhumal ...	3	...	...	...	.....	.....	.....	...	Incomplete.
158	Babar Haribhai ...	Anand ...	Samarkha ...	2½	82 0	1,000	3,000	196 7 5	32 12 0	229 3 5	2 12 9	Successful.
159	Motibhai Vithalbhai ...	Do. ...	Do. ...	2½	...	...	...	.....	.....	.....	...	Incomplete.
160	Ishwar Trikam ...	Borsad ...	Rupiapura ..	2½	104 6	500	1,000	114 11 5	135 0 0	249 11 5	2 6 1	Successful.
161	Sarjoodasji Baldevdasji.	Anand ...	Sarsa ...	2½	62 0	500	1,000	81 14 11	115 0 0	196 14 11	3 2 10	Do.
162	Ochhavlal Ramkrishna .	Do. ...	Anand ...	6	98 0	1,000	16,000	633 11 11	110 0 0	743 11 11	7 11 2	Do.
163	Zaverbhai Mathurbhai .	Nadiad ...	Saloon ...	3	55 0	1,000	4,000	63 5 9	27 0 0	90 5 9	1 10 3	Do.
	Ahmedabad District.											
164	Ambalal Narandas ...	N. Daskroi ...	Chadaval ...	4	66 0	1,000	6,000	113 6 6	59 0 0	172 6 6	2 8 2	Successful.
165	Ashabhai Narandas ...	S. Daskroi ...	Narol ...	4	93 0	1,000	3,000	154 10 1	156 7 0	311 1 0	3 5 6	Do.

Serial Number.	Name of well owner.	Taluka.	Village.	Diameter of bore.	Depth of boring.	Water before boring per hour in gallons.	Water after boring per hour in gallons.	Departmental charge.	Labour charge.	Total cost of bore hole.	Cost per foot.	Result and Remarks.
	Ahmedabad District —continued.			Inches.	Ft. In.			Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	
166	Lalloobhai Napuji ...	N. Daskroi ...	Jamiatpura ...	2½	62 0	1,000	2,000	63 13 0	79 2 0	142 15 0	2 4 7	Successful.
167	Jamnadas Keshavlal ...	Do. ...	Uvarsad ...	2½	51 0	500	1,000	66 12 6	37 7 0	104 3 6	2 0 8	Do.
168	Balakdas Laxmandas ...	Do. ...	Do. ...	2½	66 0	500	2,000	91 3 5	53 3 0	144 6 5	2 3 0	Do.
169	Agricultral Company ...	Do. ...	Amarai ...	4	50 0	1,000	3,000	113 5 4	130 0 0	243 5 4	4 13 9	Do.
170	Lalloobhai Vardhabhai.	Dholka ...	Dholka ...	4	...	...	...	.....	.....	.....	...	Incomplete.
171	Bechar Kalidas ...	S. Daskroi ...	Kanbha ...	2½	80 0	500	1,000	99 15 8	31 12 0	171 11 8	2 2 4	Successful.
172	Gala Ganga ...	N. Daskroi ...	Sanoda ...	4	38 0	500	1,000	88 3 2	40 0 0	128 3 2	3 5 5	Do.
173	Harjibhai Harabhai ...	Dholka ...	Dholka ...	3	28 0	500	1,000	54 2 0	15 4 0	69 6 0	2 7 7	Do.
174	Punjabhai Bhulabai ...	S. Daskroi ...	Nadej ...	4	48 6	500	1,000	75 10 0	31 4 0	106 14 0	2 3 3	Do.
175	Do. ...	Do. ...	Do. ...	4	28 0	1,000	2,000	62 14 5	15 10 0	78 8 5	2 12 10	Do.
176	Ranchod Pitambar ...	N. Daskroi ...	Uvarsad ...	2½	70 0	500	1,000	122 4 0	82 8 0	204 12 0	2 14 9	Do.
177	Harjibhai Hirabhai ...	Dholka ...	Dholka ...	3	87 0	...	...	.....	.....	.....	...	Unsuccessful.
178	Himatlal Harilal ...	S. Daskroi ...	Ode ...	4	60 0	1,000	2,000	110 6 1	247 4 0	357 10 1	5 15 4	Successful.
179	Ishwarbhai Jeshangbhai	Do. ...	Bhuvaldi ...	2½	51 0	...	...	.....	.....	.....	...	Unsuccessful.
180	Punjabhai Bhulabhai ...	Do. ...	Nadej ...	4	49 0	1,000	2,000	91 7 10	32 8 0	123 15 10	2 7 10	Successful.
181	Gokalbhai Jivabhai ...	Do. ...	Bhuvaldi ...	2½	80 0	...	...	.....	.....	.....	...	Unsuccessful.
182	Maneklal Bhogilal ...	Do. ...	Vastralpura...	4	62 0	...	2,000	112 2 8	44 10 0	156 12 8	2 8 6	Successful.
183	Bhulabhai Devjibhai ...	Dholka ...	Dholka ...	3	42 0	...	...	.....	.....	.....	...	Unsuccessful.
184	Dalsookbhai Lalloobhai.	S. Daskroi ...	Barejdi ...	4	54 0	1,000	3,000	115 6 0	33 0 0	148 6 0	2 10 0	Successful.
185	Punjabhai Bavabhai ...	Do. ...	Vehelal ...	4	65 0	1,000	2,000	183 8 3	71 6 0	254 14 3	3 14 9	Do.
186	Harijibhai Hirabhai ...	Dholka ...	Dholka ...	3	133 0	...	...	.....	.....	.....	...	Unsuccessful.
187	Samabhai Haribhai ...	S. Daskroi ...	Vehelal ...	4	76 0	1,000	2,000	196 7 9	42 0 0	238 7 9	3 5 8	Successful.
188	Bhikaji Dorabji ...	Do. ...	Khokra Mehmdabad.	3	80 0	500	1,000	218 8 11	150 0 0	368 8 11	4 3 7	Do.
189	Jamnadas Dayabhai ...	N. Daskroi ...	Por ...	2½	64 0	500	1,000	128 5 1	82 8 0	210 13 1	3 4 6	Do.
190	Chhagan Ghela ...	S. Daskroi ...	Vehelal ...	4	64 0	1,000	4,000	325 8 11	110 15 0	436 7 11	6 13 0	Do.
191	Lalji Samji ...	Prantij ...	Faletpur ...	2½	...	...	...	.....	.....	.....	...	Incomplete.
192	Motiji Hariji ...	S. Daskroi ...	Nadej ...	4	20 0	1,000	2,000	183 14 8	26 4 0	210 2 8	10 8 10	Successful.
193	Harjibhai Hirabhai ...	Dholka ...	Dholka ...	3	20 0	500	1,000	71 15 9	30 0 0	101 15 9	5 1 7	Do.
194	Madaji Ranaji ...	S. Dakroi ...	Nadej ...	4	52 0	...	...	.....	.....	.....	...	Unsuccessful.
195	Harjibhai Hirabhai ...	Dholka ...	Dholka ...	3	24 0	500	1,000	81 8 1	19 4 0	100 12 1	4 3 2	Successful.
196	Do. ...	Do. ...	Do. ...	3	27 0	500	1,000	80 15 10	16 8 0	97 7 10	3 9 9	Do.
197	Thakor Dipsingji ...	Tintoi ...	Tintoi ...	4	...	...	...	.....	.....	.....	...	Incomplete.
198	Bhika Jetha ...	Dholka ...	Dholka ...	3	20 0	1,000	2,000	69 5 2	25 0 0	94 5 2	4 11 5	Successful.
199	Ranchod Ambaram ...	Do. ...	Do. ...	3	...	...	...	.....	.....	.....	...	Incomplete.
	Surat District.											
200	Government Distillery...	Surat ...	Surat ...	4	64 0	...	1,000	122 11 3	45 0 0	167 11 3	2 9 11	Successful.
201	Do. do. ...	Do. ...	Do. ...	4	58 0	...	1,000	113 7 6	65 0 0	178 7 6	3 1 2	Do.
202	Do. do. ...	Do. ...	Do. ...	4	90 0	...	1,000	131 7 7	60 0 0	191 7 7	2 2 0	Do.
203	Do. do. ...	Do. ...	Do. ...	4	85 0	...	1,000	160 4 3	115 0 0	275 4 3	3 3 9	Do.
204	Do. do. ...	Do. ...	Do. ...	4	60 0	...	1,000	52 10 3	50 0 0	102 10 3	1 11 4	Do.
205	Dhoolabhai Bechar ...	Chorasi ...	Rander ...	4	36 0	...	2,000	78 6 6	45 0 0	123 6 6	3 6 10	Do.
206	Gordhan Nathoobhai ...	Do. ...	Do. ...	4	24 0	500	1,000	60 6 2	50 0 0	110 6 2	4 9 9	Do.
207	Balabhai Kasandas ...	Do. ...	Do. ...	4	...	...	...	.....	.....	.....	...	Unsuccessful.
208	Phirojsha Vikaji ...	Pardi ...	Pardi ...	4	...	...	...	.....	.....	.....	...	Incomplete.
209	Balabhai Kasandas ...	Chorasi ...	Adajan ...	4	16 0	500	2,000	95 10 6	45 0 0	140 10 6	8 12 7	Successful.
210	Do. do. ...	Do. ...	Katargam ...	4	...	...	...	.....	.....	.....	...	Incomplete.
211	Government Distillery .	Surat ...	Surat ...	4 2½	60 0	...	1,000	497 2 9	408 0 0	905 2 9	5 14 7	Successful.
	Panchmahals District.											
212	Government Farm ...	Dohad ...	Dohad ...	3	11 9	15	Nil ...	.....	Not known	.....	...	Unsuccessful.
213	Do. do. ...	Do. ...	Do. ...	3	103 5	15	200	.....	Do.	.....	...	Successful.
214	Bamanji A. Dalal ...	Halol ...	Rustampura .	3	...	...	...	.....	.....	.....	...	Incomplete.
215	Dandbhai Jivabhai ...	Dohad ...	Dohad ...	3	...	...	...	.....	.....	.....	...	Do.
	DECCAN.											
	Satara District.											
216	A. M. Kuber ...	Koregaon ...	Dahiwadi ...	3	21 2	2,500	3,500	26 14 9	81 2 6	108 1 3	5 2 3	Successful.
217	Do. ...	Do. ...	Do. ...	3	30 0	2,500	3,500	34 1 0	128 10 0	162 11 0	5 6 1	Do.

Serial Number	Name of well owner.	Taluka.	Village.	Diameter of bore.	Depth of boring.	Water before boring per hour in gallons.	Water after boring per hour in gallons.	Departmental charge.	Labour charge.	Total cost of bore hole.	Cost per foot.	Result and Remarks.
	Satara District—contd.			Inches.	Ft. In.			Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	
218	A. M. Kuber ...	Koregao ...	Dahiwadi ...	3	15 0	2,500	3,500	15 4 1	70 8 0	85 12 1	5 11 5	Successful.
219	Gundu Baba Gavai ...	Aund State ...	Aund ...	3	18 0	...	...	.....	.....	.....	...	Unsuccessful.
220	V. V. Karbhari ...	Do. ...	Do. ...	3	42 0	250	300	22 11 0	68 3 0	90 14 0	2 2 7	Successful.
221	Chief of Aundh ...	Do. ...	Do. ...	3	34 0	...	50	19 13 0	57 8 0	77 5 0	2 4 5	Do.
222	Do. ...	Do. ...	Do. ...	3	10 0	...	500	6 9 0	24 1 0	30 10 0	3 1 0	Do.
223	Tormal ...	Satara ...	Aitawda ...	...	...	...	...	.....	.....	.....	...	Incomplete.
224	R. R. Kale ...	Do. ...	Satara ...	...	...	...	...	.....	.....	.....	...	On hand.
	Belgaum District.											
225	Government Farm ...	Gokak ...	Arbhawi Farm.	3	154 0	...	960	133 11 4	129 9 8	283 5 7	1 13 7	Successful.
226	City Municipality ...	Do. ...	Gokak ...	3	100 0	...	...	.....	.....	.....	...	Unsuccessful.
227	Experimental Bore ...	Do. ...	Maldini ...	3	...	...	...	.....	.....	.....	...	On hand.
	Bijapur District.											
228	Taluka Local Board ...	Bagalkot ...	Shirur ...	3	60 0	...	...	.....	.....	.....	...	Incomplete. Mishap of tool.
229	Do. do. ...	Do. ...	Do. ...	3	150 0	...	...	.....	.....	.....	...	Unsuccessful.
230	Do. do. ...	Do. ...	Manikatti ...	3	...	...	...	.....	.....	.....	...	On hand.
231	N. K. Kohekar ...	Indi ...	Indi ...	3	30 0	...	...	.....	.....	.....	...	Incomplete, owing to owner's request.
	Sholapur District.											
232	Taluka Local Board ...	Karmala ...	Karmala ...	3	80 0	...	...	.....	.....	.....	...	Unsuccessful.
233	Do. do. ...	Do. ...	Do. ...	3	30 0	...	250	31 0 6	65 8 0	96 8 6	3 3 6	Successful.
234	Do. do. ...	Do. ...	Do. ...	3	54 6	...	650	28 15 3	31 0 6	60 10 3	1 1 11	Do.
235	Jog Pleader ...	Pandharpur .	Karkam ...	3	23 0	...	150	50 10 0	77 8 0	128 2 0	5 9 1	Do.
236	Sholapur Spinning and Weaving Company.	Sholapur ...	Sholapur ...	3	...	...	...	.....	.....	.....	...	On hand.
	Nasik District.											
237	N. N. Patel ...	Nasik ...	Deolali ...	3	30 0	No water.	250	8 6 1	65 8 0	73 14 1	2 7 5	Successful.
238	Do. ...	Do. ...	Do. ...	3	38 0	...	...	.....	.....	.....	...	Incomplete, at owner's request.
239	Ismailji Mahamadalli ...	Do. ...	Do. ...	3	12 4	...	...	.....	.....	.....	...	Do.
240	Ardesir Rustomji Engineer.	Do. ...	Do. ...	3	50 0	...	250	17 5 11	46 11 6	64 1 5	1 4 6	Successful.
241	Dinshaw K. Watcha ...	Do. ...	Do. ...	3	30 0	...	250	7 0 5	36 3 0	43 3 5	1 7 0	Do.
242	F. H. Sessionwala ...	Do. ...	Do. ...	3	50 2	500	1,500	31 0 0	66 1 0	97 1 0	1 14 5	Do.
243	Do. ...	Do. ...	Do. ...	3	50 0	...	250	30 11 0	56 14 0	87 9 0	1 11 6	Do.
244	Do. ...	Do. ...	Do. ...	3	43 0	...	250	16 12 4	36 7 0	53 3 4	1 3 9	Do.
245	D. H. Bharucha ...	Do. ...	Do. ...	3	40 0	...	250	42 6 0	48 12 0	91 2 0	2 4 5	Do.
246	D. C. Oomerigar ...	Do. ...	Do. ...	3	30 0	150	240	7 3 0	24 10 6	31 13 6	1 0 11	Do.
247	Do. ...	Do. ...	Do. ...	3	75 0	...	240	48 1 8	113 12 0	161 13 8	2 4 8	Do.
	Thana District.											
248	G. N. Pimputkar ...	Umbergaon Peta.	Umbergaon ...	3	23 0	1,000	3,500	37 7 5	64 9 6	102 0 11	4 6 8	Successful.
249	Do. ...	Do. ...	Do. ...	3	25 0	1,000	3,000	33 8 6	65 8 0	99 0 6	3 15 5	Do.
250	V. K. Sanjanwala ...	Do. ...	Do. ...	3	35 0	...	1,500	20 10 10	53 0 0	73 10 10	2 1 8	Do.
251	Do. ...	Do. ...	Sanjan ...	3	32 0	...	3,000	30 14 6	37 4 0	68 2 6	2 2 1	Do.
252	Do. ...	Do. ...	Do. ...	3	...	...	...	.....	.....	.....	...	On hand.
253	Indulkar M. N. ...	Do. ...	Wase ...	3	81 0	...	...	.....	.....	.....	...	Incomplete.
	Khandesh District.											
254	Phatak Press Company.	Dhulia ...	Dhulia ...	3	149 6	...	150	26 11 0	135 10 0	162 5 0	1 1 4	Successful.
255	Jayram Jodharaj ...	Do. ...	Do. ...	3	29 0	...	...	.....	.....	.....	...	Incomplete, at owner's request.
256	Dalpatrao Patil ...	Shindkheda .	Warsi ...	3	60 6	...	...	.....	.....	.....	...	Unsuccessful.
257	Dagdu Rangari ...	Do. ...	Do. ...	3	23 0	...	...	.....	.....	.....	...	Do.
258	Bapoo Dila Vald Patil ...	Erandole ...	Pimple ...	3	43 0	...	...	.....	.....	.....	...	Do.
259	S. C. Hosalli ...	Bhusawal ...	Halkheda ...	3	...	...	...	.....	.....	.....	...	On hand.
	Sindh District.											
260	Local Board ...	Nawabshah...	Nawabshah ...	4	96 0	...	...	207 0 0	180 0 0	387 0 0	3 15 11	Successful.
261	Do. ...	Karachi ...	Karachi ...	4	32 0	...	...	107 4 0	21 2 0	128 6 0	4 0 2	Do.
	Kolaba District.											
262	Alibag Farm ...	Alibag ...	Alibag ...	3	38 0	...	...	.....	.....	.....	...	Incomplete. Mishap of tool.
263	Taloja Local Board ...	Kajat ...	Taloja ...	3	67 3	150	250	19 0 0	176 4 0	195 4 0	2 14 0	Successful brackish water was tapped.
264	Tare Local Board ...	Panvel ...	Tare ...	3	30 0	...	...	.....	.....	.....	...	On hand.

Serial Number.	Name of well owner.	Taluka.	Village.	Diameter of bore.	Depth of boring.	Water before boring per hour in gallons.	Water after boring per hour in gallons.	Departmental charge.	Labour charge.	Total cost of bore hole.	Cost per foot.	Result and Remarks.
	North Kanara District.			Inches.	Ft. In.			Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	
265	Experimental Bore ...	Kumta ...	Kumta ...	Tube Well.	30 0	...	...	.....	.....	.....	...	Unsuccessful.
	Poona District.											
266	B. S. Kamat ...	Haveli ...	Poona ...	3	93 0	...	...	.....	.....	.....	...	Unsuccessful.
267	Executive Engineer ...	Baramati ...	Kedgaon ...	4	151 2	...	...	.....	.....	.....	...	Do.
268	Do. ...	Do. ...	Do. ...	4	58 6	...	...	.....	.....	.....	...	Do.
269	Do. ...	Do. ...	Do. ...	4	100 9	...	...	.....	.....	.....	...	Do.
	Dharwar District.											
270	Agricultural School ...	Haveri ...	Devi-Hosur ...	3	63 0	...	250	.....	Not known.		...	
271	W. G. Kelkar ...	Do. ...	Haveri ...	3	67 1	...	300	83 15 0	59 14 0	143 13 0	2 3 2	Successful.
272	Kotrappa B. Gangir ...	Karasgi ...	Devgiri ...	3	...	...	...	.....	.....	.....	...	On hand.
273	V. B. Alur ...	Ron ...	Alur ...	3	44 4	...	140	78 3 0	91 10 6	169 13 6	3 13 1	Successful.
	Ichalkaranji State.											
274	Chief of Ichalkaranji ...	Ichalkaranji.		3	45 0	...	...	.....	Not known.		...	Successful.

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Poona.

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